RCRA - Compliance Sampling Inspection (CSI)
(Final Report)

Proteccion Tecnica Ecologica (Proteco)
Road 385, Km. 3.5
Penualas, Puerto Rico 00724

PRD091018622

February 3 to 5, 1987

Participating Personnel:

U.S. Environmental Protection Agency

J. Cosentino, Environmental Scientist
L. DiGuardia, Geologist
M. Ferriola, Environmental Scientist
S. Hale, Env. Protection Specialist
N. Magriplés, Chemical Engineer
H. Chan, Environmental Engineer
A. Hernandez, Chemical Engineer

Facility Personnel:

Proteco

Juan Enrique Negron, Compliance Officer

Report Prepared by:

Joseph V. Cosentino 3-26-87

Joseph V. Cosentino, Environmental Scientist
Source Monitoring Section

Approved for the Director by:

4/1/87

Objective:

A RCRA Compliance Sampling Inspection (CSI), was conducted at Proteccion Tecnica Ecologica on February 3, 4 and 5, 1987. The scope of this inspection included the collection of groundwater monitoring well samples, a review of the facility's groundwater sampling plan and an oversight of the execution of the groundwater sampling plan. Sample locations and analytes of interest were provided by members of EPA's Region II, Hazardous Waste Compliance Branch. The locations selected included the following wells: 36-WS, 36-WVS, 51-WD, 51-WD, 52-WD, 15-WD, 27-WD and 50-WD. Figure 1 depicts approximate well locations relative to the hazardous waste management units at this site. The analysis requested included: purgeable organics (POA), non-volatile organics (NVOA) and metals (arsenic, beryllium, cadmium, chromium, copper, mercury, lead, nickel, antimony, selenium, silver, thallium and zinc).

Sampling Activities:

In order to fulfill the objectives of this inspection, groundwater samples were collected from seven (7) monitoring wells. Wells 27-WD, 50-WD, 51-WD and 52-WD are newly installed wells which monitor a reef limestone aquifer. Wells 36-WS and 36-WVS were selected to determine recharge effects at the site. Well 15-WD was selected to verify results of a previous sampling inspection.

Prior to sampling, physical measurements of well depth, well diameter and static water level were collected. This data is presented in Table 4. Each well, except 15-WD and 36-WS, was evacuated by removing a minimum of three volumes of standing water to assure samples representative of the underlying aquifer systems. Well evacuation was accomplished using teflon bailers and teflon coated stainless steel wire. To minimize the possibility of cross contamination, dedicated bailers and teflon coated stainless steel wire were used for each well. Monitoring well 15-WD was taken to dryness after evacuation of approximately two well volumes and only two well volumes were evacuated from well 36-WS due to erroneous water column calculations. During evacuation, pH and temperature were monitored. The values reported in Table 3 are believed to represent groundwater equilibrium. Subsequent sampling was accomplished using teflon bailers dedicated to each well. All wells, except well 51-WD, were evacuated and sampled by ESD personnel. Well 51-WD was evacuated and sampled by Proteco personnel to demonstrated execution of their groundwater sampling plan.

All samples were collected in accordance with established EPA, Region II protocol. Proteco personnel did not request split samples. As required under section 3007 (a) of RCRA a receipt for samples was signed by facility personnel and is attached. Sample preservation, when required, took plac immediately after collection. In addition all samples were iced. Standard EPA chain of custody procedures were employed throughout this inspection. All analyses were performed by EPA's Region II Laboratory in Edison, New Jersey.
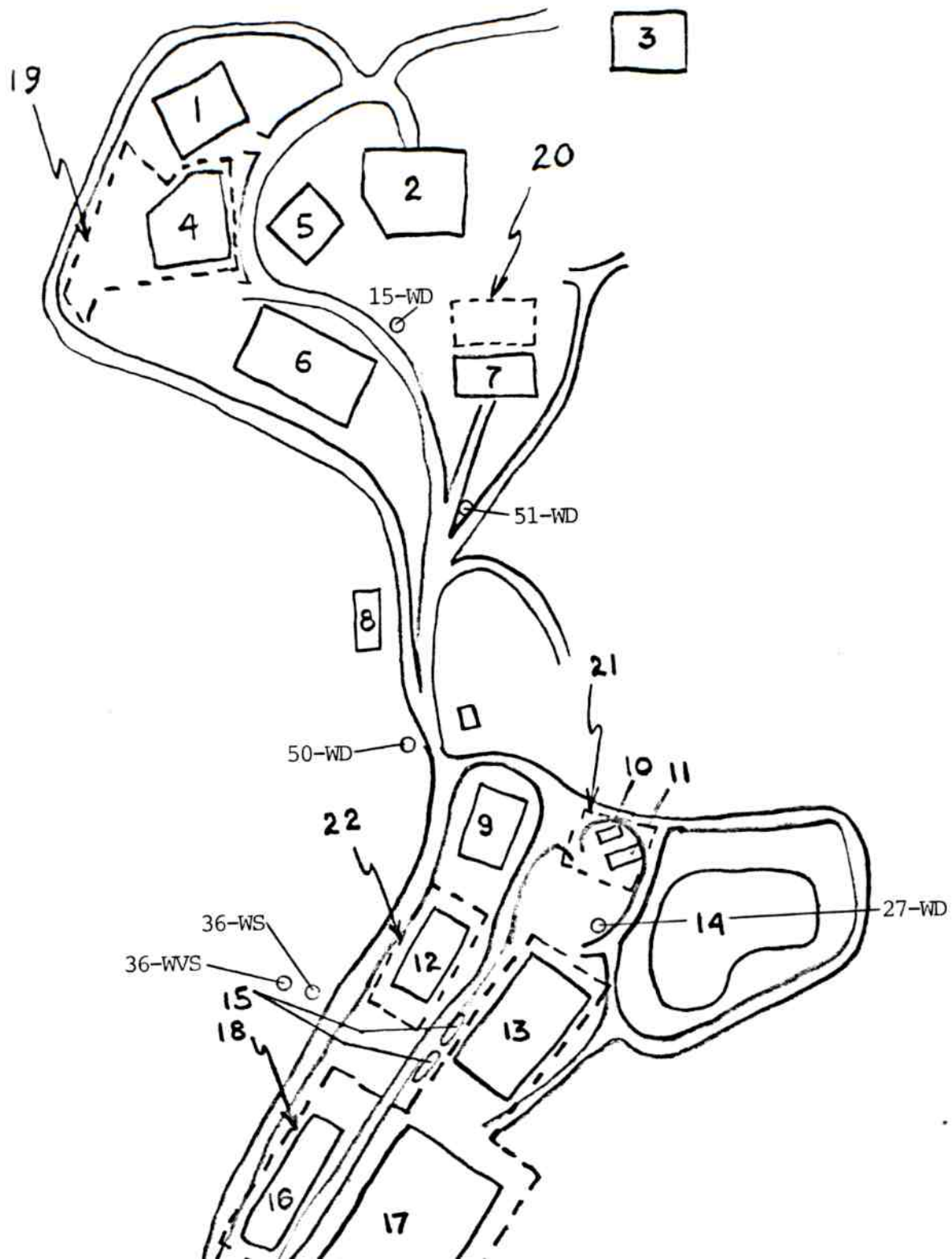
Figure - 1

— SERVICIOS CARBAREON, INC. —

FACILITY DRAWING

<u>Servicios Carbareon, Inc.</u>

<u>Site Map Legend</u>

<u>Numerical Designation</u>   <u>Unit Description</u>

1 .... Landfill, pre-RCRA drum burial

2 .... Landfill, pre-RCRA drum burial

3 .... Landfill, pre-RCRA drum burial

4 .... Drum storage area (active)

5 .... Landfill, pre-RCRA drum burial

6 .... Sanitary landfill

7 .... Lagoon, corrosive waste

8 .... Landfill, pre-RCRA drum burial

9 .... Lagoon, oil

10 .... Immobilization area

11 .... Immobilization area

12 .... Land application area

13 .... Lagoon, rainwater (active)

14 .... Land application, non-hazardous

15 .... Tank storage area

16 .... Immobilization area (active)

Oversight Activities:

As part of this inspection the facility was asked to evacuate and sample well 51-WD. This was done to allow EPA personnel to oversee the field tecniques employed by Proteco personnel. These activities were undertaken by; J. Serrano, G. Rodriguez, M. Hernandez and M. Amaro.

Prior to evacuation and sampling physical measurement of the static water level was made using a water level indicator. The water level indicator was then decontaminated using methanol and distilled water rinses. The static water level is then used to calculate casing volume using the equation $V = 5.88 \ D^2 \ (Lwc - Ldtw)$ where: V = standing water volume, D = diameter of well casing, Lwc = total length of well casing and Ldtw = depth to water in well. The well diameter and total depht of the well were taken from drilling logs. A volume equal to three casing volumes was then calculated.

Evacuation was accomplished by manually bailing the well. A teflon bailer and teflon coated stainless steel cable were ultilized for this task. The bailer was a 1.5 inch diameter, bottom loading, thin walled teflon bailer with a check valve. Prior to use, the bailer had been wrapped in aluminum foil and according to facility personnel decontaminated using the following procedure; non-phosphate detergent wash, tap water rinse, acetone rinse, hexane rinse, acid rinse, deionized water rinse and air dried. A sheet of plastic was placed on the ground adjacent to the well to keep the bailer cable from contacting the ground surface during the evacuation process. The evacuated groundwater was collected in a calibrated bucket and disposed of in a 55 gallon steel drum. Evacuation continued until three casing volumes had been removed, which in the case of well 51-WD was calculated to be approximately 37 gallons.

Sampling was accomplished by manually bailing water from the well using a thin walled teflon bailer. Sample volumes for POA, NVOA and metals were collected by pouring the groundwater samples from the bailer. Care was taken during the sampling process to minimize sample agitation and alteration.

All relative information generated during the evacuation and sampling of well 51-WD was recorded by Proteco personnel.

Results of Analysis:

The data obtained from the samples collected at groundwater monitoring wells 36-WS, 36-WVS, 51-WD, 52-WD, 15-WD, 27-WD and 50-WD are presented in Tables 1, 2 and 3. Table 1 presents the results of metals analysis on the samples collected. Table 2 presents the organic constituents that were identified in the samples. Table 3 presents the in-situ measurements of pH and temperature.

Results of Groundwater Monitoring Oversight:

The groundwater monitoring techniques displayed by Proteco personnel during the the evacuation and sampling of well 51-WD appear to conform with the groundwater monitoring techniques outlined in the RCRA Ground-Water Monitoring Technical Enforcement Guidance Document. However, it should be noted that the facility did not request or collect split samples. Therefore, sample handling techniques, container types, volumes and preservation, chain of custody procedures were not observed during this inspection. Comments on these aspects of the facility's groundwater monitoring program will be made from a review of the written ground-water sampling and analysis plan. A copy of this document was obtained from facility personnel during this inspection.

Results of Groundwater Monitoring Plan Review:

A copy of the facility's groundwater monitoring plan entitled: "Proteccion Tecnica Ecologica (Proteco) Inc. Ground Water Monitoring Program Sampling and Analysis Plan" was reviewed as part of this inspection and is attached. The document was prepared by Fred C. Hart Associates, Inc. of Pittsburgh, Pennsylvania and is dated November 14, 1986 with attached revisions dated November 26, 1986. A review of the sampling procedures outlined in this plan revealed the following deficiencies:

1. The sampling plan does not specify a method for the detection of immiscible layers.

2. The sampling plan states that sample bottles will be sterilized at the laboratory by washing in HNO_3 followed by distilled water rinse. This is inappropriate as sample containers should be prepared according to the analyte of intrest, i.e. vials used for the collection of volatile organics samples require baking at 105°C and containers used for the collection of TOX samples require baking at 650°C.

3. The sampling plan specifes that a minimum of seven, wide-mouth, liter glass bottles would be collected for sample analysis. These containers types would be inadequate for a number of the analysis of intrest. However, the plan references a Table 5 which contains appropriate glassware types.

4. QA/QC procedures are not specific. Consideration should be given to the collection of equipment blanks, field blanks and the col-

lection of duplicated samples. The collection and analysis of
equipment blanks and field blanks would enable the facility to
determine the effects of equipment cleaning and sample handling
techniques. The analysis of duplicate samples would be useful
in determining the ablility of the laboratory to produce accurate
data.

All other aspects of groundwater sampling outlined in this plan appear to be
adequate and conform with the techniques suggested in the RCRA Ground-Water
Monitoring Technical Enforcement Guidance Document. This would include: well
evacuation and sampling techniques, chain of custody procedures, sample labels,
sample handling, sample shipment procedures and field recordkeeping techniques.
It also appears that the written procedures as outlined in the facility's
sampling plan are being used in the field.

- Table 1 -

Results of Metals Analysis on Groundwater Samples Collected at Proteco, PRDO91018622

	#088182 Well 36WS ug/l	#088183 Well 36WVS ug/l	#088190 Duplicate Well 36WVS ug/l	#088184 Well 51WD ug/l	#088185 Well 52WD ug/l	#088186 Well 15WD ug/l	#088187 Well 27WD ug/l	#088188 Well 50WD ug/l	#088191 Equipment Blank ug/l
	---	---	---	---	---	---	---	---	---
	M	M	M	---	---	---	---	---	---
n	---	M	M	---	---	M	M	---	M
	---	---	---	---	---	---	---	---	---
	M	M	M	M	M	M	M	M	---
	36	77	75	---	40	326	34	22	---
	M	---	---	M	---	---	M	M	M
	---	---	---	---	---	---	---	---	---
	M	607	570	---	---	580	---	---	---
	M	M	M	---	M	M	5.2	M	M
	M	M	M	M	M	---	---	M	---
	---	---	---	---	---	M	---	---	---
	---	M	M	M	M	M	M	M	M

M = Presence of material verified, but not quantified

--- = Material analyzed for, but not detected

- Table 2 -

Results of Organics Analysis on Groundwater Samples Collected at Proteco

Compound	#088186 Well 15WD ug/1	#088187 Well 27 ug/1	#088188 Well 50WD ug/1	#088189 Field Blank ug/1	#088191 Equipment Blank ug/1
1,2-dichloroethane	---	M	---	---	---
di-n-butylphthalate	---	---	---	---	---
butyl benzyl phthalate	---	---	---	---	---
di-n-octyl phthalate	---	---	M	---	---
bis(2-ethylhexyl) phthalate	---	63	---	---	---
vinyl chloride	---	---	230	---	---
chloroethane	---	---	---	---	---
methylene chloride	---	---	---	---	---
1,1-dichloroethylene	---	M	230	---	---
1,1-dichloroethane	---	---	64	---	---
1,2-trans dichloroethylene	---	---	230	---	---
chloroform	---	---	260	---	---
1,1,1-trichloroethane	---	M	45	---	---
trichloroethylene	---	M	250	---	M
tetrachloroethyene	M	M	970	M	---
benzene	---	---	40	---	---
toluene	---	---	M	---	---
1,1,2-trichloroethane	---	---	---	---	---
chlorobenzene	---	---	---	---	---
naphthalene	---	---	---	---	---
n-nitrosodimethylamine	---	---	---	---	---

M = Presence of material verified, but not quantified
--- = Material analyzed for, but not detected

- Table 2 -

Results of Organics Analysis on Groundwater Samples Collected at Proteco, PRD091018622

Compound	#088182 Well 36WS ug/l	#088183 Well 36WVS ug/l	#088190 Duplicate Well 36WVS ug/l	#088184 Well 51WD ug/l	#088185 Well 52WD ug/l
1,2-dichloroethane	76	13,000	13,000	---	---
di-n-butylphthalate	320	1,050	---	---	---
butyl benzyl phthalate	4.5	---	---	---	---
di-n-octyl phthalate	---	---	---	---	4.5
bis(2-ethylhexyl) phthalate	---	---	---	---	280
vinyl chloride	---	20	21	---	---
chloroethane	---	3	4.5	---	---
methylene chloride	---	22	24	---	---
1,1-dichloroethylene	---	110	120	---	---
1,1-dichloroethane	---	130	140	---	---
1,2-trans dichloroethylene	---	10	11	---	---
chloroform	---	7.3	8.0	---	0.4
1,1,1-trichloroethane	---	110	100	---	---
trichloroethylene	---	10	9.8	---	M
tetrachloroethyene	---	---	M	---	---
benzene	---	33	33	---	---
toluene	---	---	---	---	---
1,1,2-trichloroethane	---	M	M	---	---
chlorobenzene	---	M	M	---	---
naphthalene	---	5.2	5.8	---	---
n-nitrosodimethylamine	---	2.9	---	---	---

M = Presence of material verified, but not quantified
--- = Material analyzed for, but not detected

- Table 3 -

Results of In Situ Paramter Analysis on Groundwater Samples Collected at Proteco

	Well 36WS	Well 36WVS	Well 51WD	Well 52WD	Well 15WD	Well 27WD	Well 50WD
	6.47	6.48	7.08	9.40	6.35	7.10	6.73
re (°C)	28.5	28.0	---	26.3	26.7	26.8	27.2

— Table 4 —

Measurements Collected Prior to Monitoring Well Evacuation and Sample Collection at Proteco, PRD091018622

nts	Well 36WS	Well 36WVS	Well 51WD	Well 52WD	Well 15WD	Well 27WD	Well 50WD
of ches)	2.0	2.0	2.0	2.0	2.0	2.0	2.0
ng ion material	PVC	PVC	PVC	PVC	PVC	PVC	PVC
th (feet)	51.92	22.42	216.0	245.08	61.08	187.25	207.42
ter eet)	24.83	14.17	144.46	211.67	26.83	134.08	109.75
lumn (feet)	27.09	8.25	71.54	33.41	34.25	53.17	97.67
ed (gallons)	8.5	4.2	37	18	15.0**	25.5	51

* = Volume evacuated to dryness

ote: all wells sampled were fitted with protective steel casings,
locking caps and concrete collars at the ground surface.

RECEIPT FOR SAMPLES

ENVIRONMENTAL PROTECTION AGENCY — REGION II

Environmental Services Division

EDISON, NEW JERSEY 08817

Name of Unit and Address: PROTECO

PUERTO RICO

PRD091018622

Sample Number	Number of Containers	Description of Samples
		COLLECTED 2-3 Thru 2-5-87
088182	—	WELL 36 WS
088183	—	WELL 36 WVS
088184	—	WELL 51 WD
088185	—	WELL 52 WD
088186	—	WELL 15 WD
088188	—	WELL 50 WD
088187	—	WELL 27 WD

— SAMPLES FOR POA, NVOA & METALS ANALYSIS
WERE COLLECTED FROM THE ABOVE WELLS

— THE FACILITY DID NOT REQUEST SPLIT SAMPLES

✱ _J.E. Negrón_ 2/5/87

		Time	Date
Person Assuming Responsibility for Sample:			

Sample Number	Relinquished By:	Received By:	Time	Date	Reason for Change of Custody

Fred C. Hart Associates, Inc.

November 26, 1986
Project No. 01511-00-86002

Mr. Enrique Negron
PROTECO
Firm Delivery
Ponce, PR   00731

Dear Enrique:

Enclosed is a revised edition of the Ground Water Monitoring Sampling and Analysis Plan for Interim Status Units for the PROTECO facility. The plan has been revised in order to address specific deficiencies outlined by EPA's Quality Assurance office.

Many of the deficiencies were simply minor errors such as incorrect laboratory holding times or bottle types for specific parameters. I am pleased to note that these errors were ignored by PROTECO and EQ Lab personnel who carried out the sampling and analysis procedures correctly.

However, some revisions to the plan have been made. These revisions must be implemented starting in January with the 1987 First Quarterly Sampling Event.

Below I have outlined the following changes:

1. Sampling Equipment Decontamination-The EPA recommends the following procedure for decontamination of sampling equipment such as bailers, teflon cord, water level indicators, trowels, etc:

> Non-phosphate detergent wash
> Tap water rinse
> Acetone rinse
> Pesticide grade hexane rinse
> 10% hydrochloric acid rinse
> Deionized water rinse
> Thorough air drying before use

2. Metals Analysis- The EPA requires the analysis of total metals and dissolved metals. Therefore in the future it will be necessary to collect two samples for metals analysis.

H

The sample to be analyzed for total metals will be acidified immediately. The sample to be analyzed for dissolved metals will first be filtered, then acidified.

3. <u>Replicate Measurements</u>- In order to document the reliability of analytical procedures, certain parameters will be measured repeatedly. Please note that this entails measuring pH, specific conductance and salinity four (4) times for a single sample, not the collection of four (4) separate samples.

Please contact me with any questions you might have regarding these revisions or the plan.

Sincerely,

FRED C. HART ASSOCIATES, INC.

Marcia Findlay
Hydrogeologist

MF/dlk
cc: Jose Vila

PROTECCION TECNICA ECOLOGICA
(PROTECO) INC.

GROUND WATER MONITORING PROGRAM
SAMPLING AND ANALYSIS PLAN
REVISED

PREPARED BY:

FRED C. HART ASSOCIATES, INC.
PENN CENTER WEST III
SUITE 106
PITTSBURGH, PENNSYLVANIA   15276

NOVEMBER 14, 1986

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

GROUND WATER MONITORING PROGRAM
SAMPLING AND ANALYSIS PLAN

I. **INTRODUCTION**

This document was prepared in accordance with the requirements set forth by the United States Environmental Protection Agency (U.S. EPA) and the Puerto Rico Environmental Quality Board (E.Q.B.), pursuant to the Resource Conservation and Recovery Act (R.C.R.A.). This document was specifically designed in compliance with paragraphs 265.91 and 265.92 of the Act and describes the Ground Water Monitoring Program and Sampling and Analysis Plan for the Proteccion Tecnica Ecologica, Inc. (PROTECO) Facility in Penuelas, Puerto Rico.

The primary objective of the PROTECO Ground Water Monitoring Program and Sampling Analysis Plan is to evaluate the impact of individual regulated units on the quality of ground water underlying the facility. This Ground Water Monitoring Program was developed to monitor the uppermost aquifer or water bearing geologic unit beneath regulated units at the facility. This general approach to ground water monitoring is appropriate because the uppermost water bearing geologic unit is the most probable route for contaminant migration from individual regulated units. Monitoring of this zone would therefore provide the earliest possible detection of leakage from regulated units.

The PROTECO Ground Water Monitoring Program consists of point of compliance monitoring wells located down gradient from each regulated unit. Regulated unit specific water quality parameters have been established for each existing unit based upon the type of waste(s) placed in the subject unit. In this way, the ground water monitoring network in conjunction with procedures described in the Sampling and Analysis Plan, will be capable of detecting leakage from individual regulated units.

Presently, this Ground Water Monitoring Program applies to the monitoring of two (2) existing regulated units. They are the Rainwater Basin and the Immobilization Faciltiy (TI_3). The location of these regulated units is illustrated on Figure 1. As new facilities are constructed, the Ground Water Monitoring Program and Sampling and Analysis Plan will be amended to include the appropriate information for each new regulated unit.
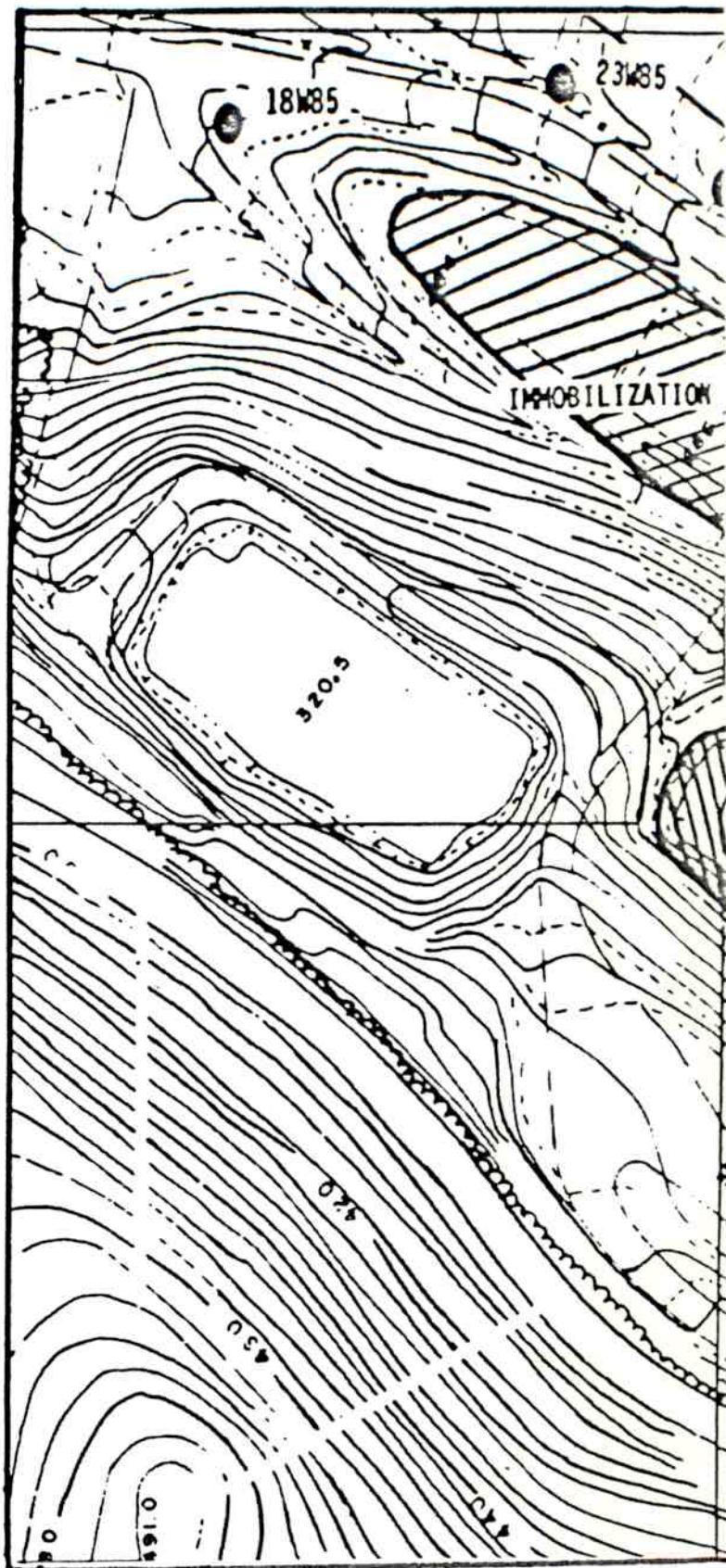
Figure 1

**IMMOBILIZATION UNIT (TI₃) AND
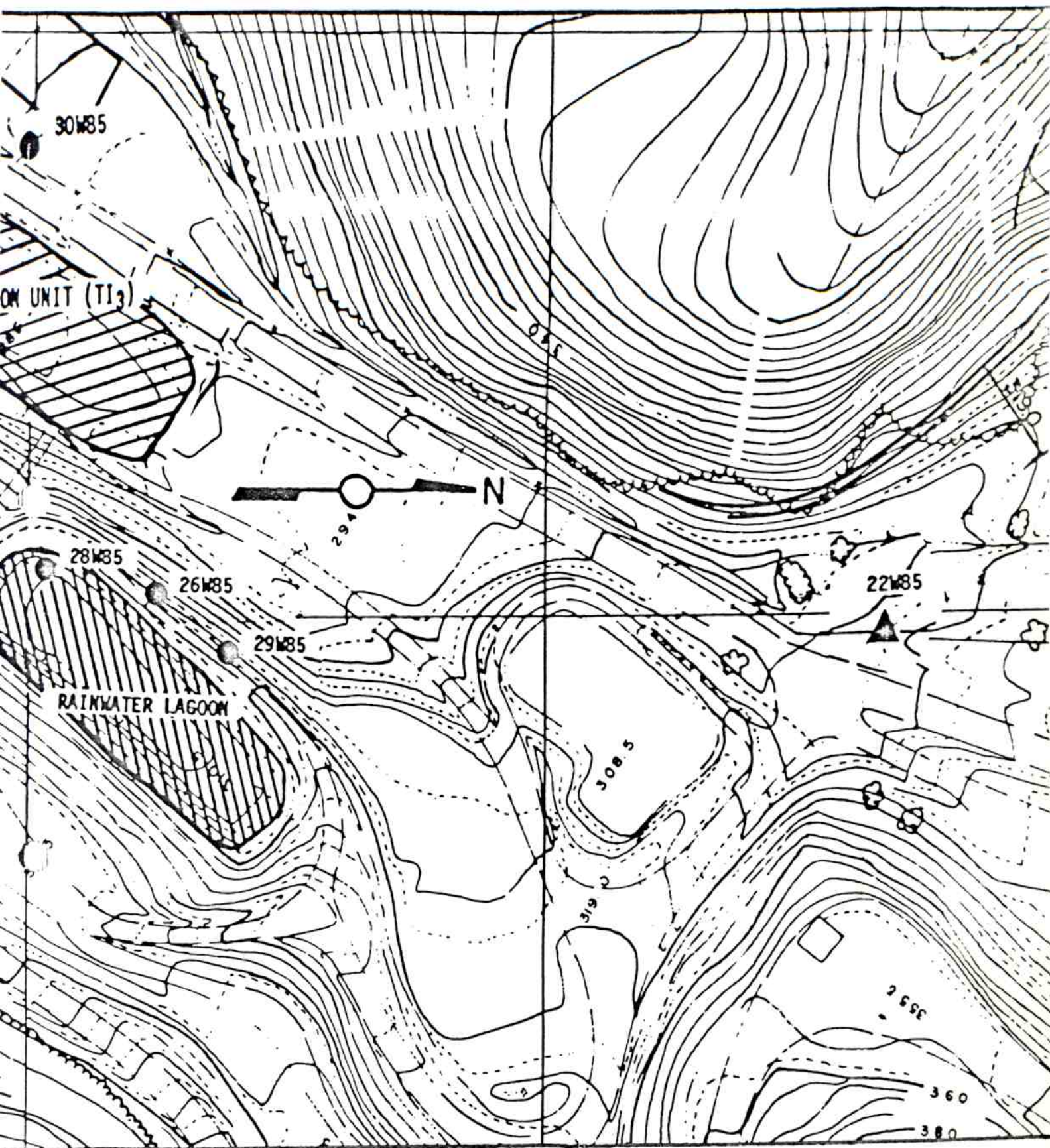RAINWATER LAGOON LOCATIONS**

FRED C. HART ASSOCIATES, INC.

○ — Downgradient monitoring well

△ — Upgradient monitoring well
for Rainwater Lagoon and
Immobilization Unit (TI₃)

30W85

ON UNIT (TI₃)

N

28W85

26W85

29W85

RAINWATER LAGOON

22W85

SCALE

II. DESCRIPTION OF GROUND WATER MONITORING NETWORK

In accordance with Subpart F - Ground Water Monitoring, paragraph 265.91, the Ground Water Monitoring Network for each regulated unit at the PROTECO facility consists of three (3) hydraulically downgradient monitoring wells installed at the limit of the waste management area or by definition, the point of compliance.   Furthermore, monitoring wells (downgradient and upgradient wells) are located in compliance with paragraph 264.97 to yield ground water samples from the uppermost water bearing geologic unit that are representative of the quality of ground water passing the point of compliance for each regulated unit and representative of background ground water that has not been affected by leakage from a regulated unit. A description of the ground water monitoring network for each regulated unit is listed below.

Rainwater Basin:

The ground water monitoring network for this regulated unit consists of three (3) downgradient point of compliance monitoring wells and one (1) upgradient monitoring well.   The location of each monitoring well for the Rainwater Basin is illustrated on Figure 2.   Point of compliance monitoring wells for this unit are completed to allow for monitoring of the uppermost water bearing geologic unit underlying the Rainwater Basin.   The downgradient monitoring wells are identified as wells 26W85, 28W85 and 29W85. The upgradient monitoring well is identified as 22W85. Well construction specifications for each of these monitoring wells is described in the following section of this document and a data table summarizing the details of the construction of each well is presented in Table 1.

Immobilization Facility (TI$_3$):

The ground water monitoring network for this regulated unit consists of three (3) downgradient point of compliance monitoring wells and one (1) upgradient monitoring well.   The location of each monitoring well in this network is illustrated in Figure 3. Each monitoring well is completed to yield samples from the uppermost water bearing geologic unit underlying the Immobilization Facility. The downgradient monitoring wells are identified as 18W85, 23W85 and 30W85. The upgradient monitoring well is identified as 22W85. Well construction specifications for each well is described in the following

28W85

26W85

29W85

RAINWATER LAGOON

22W85

N

⬤ - Downgradient monitoring well

△ - Upgradient monitoring well
   for Rainwater Lagoon and

Figure 2

RAINWATER LAGOON AND
MONITORING WELL LOCATIONS

23W85

18W85

30W85

IMMOBILIZATION UNIT (TI$_3$)

320

320.5

2945

Figure 3

IMMOBILIZATION UNIT (TI$_3$) AND
MONITORING WELL LOCATIONS

- Downgradient monitoring well

- For upgradient monitoring
  well location See figure 2.

TABLE 1
REGULATED UNIT MONITORING WELL SPECIFICATIONS

MONITORED UNIT	SURVEYED ELEVATION (F) TOP OF CASING	TOTAL DEPTH	SCREENED INTERVAL (FT.)	SCREEN LENGTH (FT.)	SCREEN SLOT SIZE (IN.)	WELL DIAMETER (INSIDE)	CASING MATERIAL	HYDROGEOLOGIC POSITION RELATIV TO MONITORED UNIT
Immobilization Unit TI_3	274.87	59.5	49.5 to 59.5	10	0.01	2 in.	PVC	Downgradient
Immobilization Unit TI_3	282.33	39.0	29.0 to 39.0	10	0.01	2 in.	Teflon	Downgradient
Immobilization Unit TI_3	284.13	54.0	44.0 to 54.0	10	0.01	2 in.	Teflon	Downgradient
Rainwater Lagoon	301.80	69.0	59.0 to 69.0	10	0.01	2 in.	Teflon	Downgradient
Rainwater Lagoon	299.30	74.0	64.0 to 74.0	10	0.01	2 in.	PVC	Downgradient
Rainwater Lagoon	302.04	33.8	23.8 to 33.8	10	0.01	2 in.	Teflon	Downgradient
Rainwater Lagoon and TI_3	310.89	55.0	45.0 to 55.0	10	0.01	2 in.	PVC	Upgradient

III. MONITORING WELL CONSTRUCTION

Monitoring wells installed as a part of the ground water monitoring network for each regulated unit were constructed of 2 inch inside diameter (ID) teflon or PCV riser pipe (threaded flush joint) and 2 inch ID machine slot well screen (Teflon or PVC). The annular space around the well screen was backfilled with chemically inert sand to a depth two feet above the top of each screen. A two foot bentonite seal was placed above the sand and the remainder of the annulus was backfilled to the surface with a mixture of six (6) parts Portland Type I cement to three (3) parts water and one (1) part bentonite. The monitoring well installation is protected at the surface by the placement of a one (1) foot cement seal at the top of the cement-bentonite slurry to prevent the leakage of fluids from the surface into the annulus and ultimately the monitoring detection zone.

Each monitoring well was fitted with an outer protective casing with a locking cap to prevent tampering. The protective casing is 4 inch ID steel and is installed to a minimum depth of two feet below the ground surface.

Each monitoring well was developed by surging and bailing to clear the well screen of fines and induce ground water flow into the well. Each monitoring well was developed a minimum of two times to insure that each well yields ground water with a minimum concentration of suspended solids. Diagrams illustrating the construction of regulated unit monitoring wells is presented in Appendix A.

Note of Well Construction: To insure the compatibility of monitoring well materials with the types of wastes present in existing and proposed regulated units, all permanent monitoring wells installed for the ground water monitoring of proposed regulated units will be constructed of teflon well screen and riser pipe. PVC well construction materials will be phased out of service and existing monitoring wells constructed with PVC materials will only be utilized to obtain water level data.

IV. MONITORING PARAMETERS

Monitoring Parameters:

Because the PROTECO Ground Water Monitoring Program is designed to monitor the water quality of individual regulated units, a list of parameters specifically tailored to each regulated unit has been developed. The parameter list for each regulated unit was compiled through an evaluation of the types of wastes placed in each unit. Specific parameters on each list were selected in order to characterize those contaminants present in the subject wastes that are the most mobile and persistent in the system. In order to provide the necessary justification for each regulated unit's list of parameters, the following information on the types of wastes placed in each regulated unit is presented below. Table 4 lists the characteristics of the types of wastes placed in each of these regulated units in terms of their solubility in water, sorption and biodegradablility.

In addition to specific unit parameters, general indicator parameters such as EPA primary drinking water standards, ground water quality and contamination parameters will be monitored. Tables 2 and 3 list all the parameters to be monitored for the Rainwater Basin and Immobilization Facility, respectively.

Rainwater Basin:

Because the Rainwater Basin has primarily received rainwater that was decanted from the Oil Lagoon (scheduled for closure), the following list of wastes placed in the Oil Lagoon is presented:

Oil Lagoon:

EPA I.D. Number	Category	Hazard	Capacity
D001	Ignitable	I	438,000 gal.
F005	Non-halogenated Solvents	I	104,540 gal.
U112	Ethyl acetate	T	1,170 gal.
U154	Methanol	T	2,335 gal.
U220	Toluene	T	2,920 gal. .
U226	1,1,1-Trichloroethane	T	5,035 gal.
Non-hazardous	------	-	876,000 gal.
			1,460,000 gal. total

TABLE 2

RAINWATER BASIN MONITORING PARAMETERS

PARAMETERS CHARACTERIZING THE SUITABILITY OF THE GROUND WATER AS A DRINKING WATER SUPPLY:

Arsenic	Endrin
Barium	Lindane
Cadmium	Methoxychlor
Chromium	Toxaphene
Fluoride	2,4-D
Lead	2,4,5-TP Silver
Mercury	Radium
Nitrate	Gross Alpha
Selenium	Gross Beta
Silver	Coliform Bacteria

PARAMETERS ESTABLISHING GROUND WATER QUALITY:

Chloride	Phenol
Iron	Sodium
Manganese	Sulfate

PARAMETERS USED AS INDICATORS OF GROUND WATER CONTAMINATION:

pH	Total Organic Carbon
Specific Conductance	Total Organic Halogen

SPECIFIC UNIT PARAMETERS:

Ethylbenzene	1,1,1-Trichloroethane
Toluene	1,2-Transdichloroethylene
Methylene Chloride	1,1-Dichloroethane
Xylene	Trichloroethylene

Immobilization Facility (TI$_3$):
The following wastes have been placed in the Immobilization Facility:

Immobilization Facility TI$_3$ (Existing)

EPA I.D. Number	Category	Hazard	Gallons
D001	Ignitable	I	18,260
D002	Corrosive	C	1,050
D004	Arsenic	E	40
D007	Chromium	E	1,010
D008	Lead	E	9,500
D009	Mercury	E	6,340
D011	Silver	E	40
D013	Lindane	E	100,500
F002	Halogenated Solvents	T	3,200
F003	Non-halogenated Solvents	I	27,550
F005	Non-halogenated Solvents	I, T	8,320
F006	Wastewater Treatment Sludges	T	34,460
U044	Chloroform	I, T	160
U151	Mercury	T	450
Non-hazardous	---	---	16,480
			227,360 total

TABLE 3

IMMOBILIZATION FACILITY MONITORING PARAMETERS

PARAMETERS CHARACTERIZING THE SUITABILITY OF THE GROUND WATER AS A DRINKING WATER SUPPLY:

Arsenic	Endrin
Barium	Lindane
Cadmium	Methoxychlor
Chromium	Toxaphene
Fluoride	2,4-D
Lead	2,4,5-TP Silver
Mercury	Radium
Nitrate	Gross Alpha
Selenium	Gross Beta
Silver	Coliform Bacteria

PARAMETERS ESTABLISHING GROUND WATER QUALITY:

Chloride	Phenol
Iron	Sodium
Manganese	Sulfate

PARAMETERS USED AS INDICATORS OF GROUND WATER CONTAMINATION:

pH	Total Organic Carbon
Specific Conductance	Total Organic Halogen

SPECIFIC UNIT PARAMETERS:

Ethylbenzene	1,1,1-Trichloroethane
Toluene	1,2-transdichloroethylene
Chloroform	1,1-Dichloroethane
Benzene	Trichloroethylene

TABLE 4
WASTE CONSTITUENT CHARACTERISTICS

Constituent	Solubility in Water (mg/L)	Biodegrad- ability	Sorption
Chromium	6 17 x 10^5 at 0^oC	None	Absorbed by organic materials
Lead	17 at 20^oC	None	Removed by inorganic solids
Cadmium[1]	2.6 at 25^oC	None	Removed by clays
Nickel	3.6 at 18^oC	None	Some absorption by organic matter
Cyanide	Soluble in all portions	None	Absorbed by most materials
Arsenic	1.5 x 10^6 at 16^oC	None	Removed by clays
Silver	13 at 20^oC	None	Some absorption by clays
Selenium	3.8 x 10^5 at 14^oC	None	Absorbed by clays and organic mat
Mercury	Insoluble to 6.9 x 10^{-4} at 20^oC	None	Absorbed by most particles
Xylene	Insoluble at 25^oC	Relative import- ance can- not be determined however, should be	Assumed to be absorbed by organic materials

TABLE 4 (CONTINUED)

Constituent	Solubility in Water (mg/L)	Biodegrad-ability	Sorption
Toluene	535 at 25°C	Relative importance cannot be determined; however, biodegraded by some micro-organisms	Assumed to be absorbed by organic materials
Ethylbenzene	Insoluble at 25°C	Relative importance cannot be determined; however, biodegraded by some micro-organisms	Assumed to be absorbed by organic materials
Phenol	93,000 at 25°C	98 percent removal in activated sludge	Not important
Methylene Chloride	16,700 at 25°C	Degraded by biological treatment	Data lacking, however, not expect to be an important fate mechanism

TABLE 4 (CONTINUED)

Constituent	Solubility in Water (Mg/L)	Biodegrad- ability	Sorption
1,1,1-Tri- chloroethane	950 at 20°C	Degraded by biological treatment	Information lacking, but may be a important fate mechanism
Lindane (y-Hexachlorocyclohexane)	7.5 at 25°C	Most rapid in anaero- environments.	Important for transport to anaero sediments.

[1] As hydroxide; other metal as oxides.

Sources: Treatability Manual, Volume I, "Treatability Data," U.S. EPA, Offic Research and Development, EPA-600/8-80-042a, July 1980.

Water-Related Environmental Fate of 129 Priority Pollutants, Volumes I II, U.S. EPA, Office of Water and Waste Management, EPA-440/4-79-029a December 1979.

V. SAMPLING AND ANALYTICAL PROCEDURES

GENERAL - The purpose for sampling ground water monitoring wells at the PROTECO Facility, is to collect valid representative ground water quality data from the geologic materials underlying each regulated unit. In order to accomplish this, a number of steps must be taken to assure proper sample collection, and hence the collection of valid comparable data. All samples will be collected and handled in accordance with accepted U.S. EPA Standard procedures, as described below.

All ground water monitoring wells which are included as part of the monitoring program will be sampled within a short time period (1 day) during each sampling campaign. This will help provide an overall understanding of the ground water quality throughout the hydrogeologic regime underlying the facility at the time of sampling. When conducting each sampling campaign, work will always begin at the background location and proceed downgradient. This is an added precautionary measure which helps assure that the background sample will not be affected by any materials from the downgradient locations. Protecting the integrity of the background sample is critical because these values will be used to set the standards for comparisons with downgradient values.

DETERMINATION OF WELL EVACUATION REQUIREMENTS - Before any ground water samples are collected for chemical analysis, great care will be taken to assure that the sample is representative of ground water quality in the geologic materials in the vicinity of the well, and not of standing water in the well. In order to make such an assurance, each well will be properly prepared prior to sample collection. Preparation involves removing water from the well until all standing water which is present in the well has been evacuated.

The first step of the well evacuation process is to determine the actual volume of standing water that is present in the well. This will be accomplished by solving the following equation:

$$V = 5.88 \ D^2 \ (Lwc - Ldtw)$$

where: V = Standing Volume of Water in the Well (Gallons)

D = Diameter of the Well Casing (Feet)

Once the volume of standing water in each well has been calculated, the total volume of water that must be removed prior to sample collection is determined by multiplying the standing volume by the number of volumes to be evacuated. A minimum of three (3) well volumes will be evacuated prior to sampling, if possible. If three well volumes are not available within a reasonable time period, as many volumes as possible will be evacuated. A record of water level, volume evacuated, time required for evacuation and the vertical location of sample collection will be maintained for each well. This information will be used to ensure that the same evacuation procedure, time and vertical location will be employed for each particular well for every sampling event.

In addition to enabling a calculation of the standing volume of water in the well, precise water level measurements (to .01 foot accuracy) will provide the necessary information to construct a potentiometric surface contour map. Such a map will indicate both the direction and gradient of ground water flow, and help define the particular hydrogeologic site conditions existing at the time of sampling. This type of information is very important for comparing the hydrogeologic conditions (i.e. seasonal effects) existing from one quarterly sampling campaign to another, and is necessary when interpreting sampling analysis data.

For the above mentioned reasons, and given the fact that semi-confined conditions with anticipated low horizontal flow gradients are expected at the PROTECO Facility it is very important that precise ground water elevations be measured. A complete round of water level measurements will be made at the start of each sampling campaign prior to the evacuation of any water. A transistorized water level indicator calibrated in feet will be used with the refined measurements to 0.1 inch taken manually with the mechanical rule. The procedure detailing proper use of the water level indicator is listed on the following page. The depth-to-water measurements will be used to determine 1) the volume of standing water in the wells which was described earlier and 2) ground water flow rate and direction as outlined below. A weighted line will also be used to sound the wells in order to verify the total well depths.

Procedure for using electric water level measuring device.

1   a. Check battery level by turning toggle switch to "on".

      b. Push the black button located below the meter.

      c. The needle on the meter should "peg" to the right on the meter if the batteries are good.

      d. Replace the batteries as needed.

2   a. Obtain two (2) plastic squirt bottles (approximately 300 ml each).

      b. Fill one bottle with methanol and one bottle with distilled water. (These will be used to decontaminate the wire on the water-level meter).

3   a. Unwind the lead leader and squirt with methanol.

      b. Rinse leader with distilled water.

4   a. Slowly unwind leader into the center of the well. Use a clean flat board, placed over the well casing, for support in lowering the wire down the center of the well.

      b. Stop lowering the wire when the needle moves on the meter. Slowly raise then lower the wire to be certain that the exact surface of the water has been reached.

      c. Hold the wire where it coincides with the top of the well casing.

      d. With a separate scale, measure the distance along the wire from where the wire is being held to the next lower foot mark. (The wire is marked in one (1) foot increments).

      e. This foot mark plus the "hand-measured" distance is recorded as: Depth to Water from Top of Casing (TOC). This measurement must be accurate to one one-hundreth (0.01) of one foot. A scale graduated into tenths (0.1) and hundreths (0.01) of a foot is preferable to a scale measuring fractions.

5   a. Decontamination of the leader (as described in 3 above) must be done thoroughly before lowering into the next well.

      b. This decontamination is absolutely necessary and must be performed conscienciously to prevent cross contamination of the monitoring wells.

DETERMINATION OF GROUND WATER FLOW DIRECTION - The most important factor for determining the direction of ground water flow within a given aquifer, is the gradient of the water table or potentiometric surface. This gradient is interpreted from water level measurements which are taken from the ground water monitoring wells that are screened within this interval (upper most water bearing geologic unit) below the site. The resulting ground water elevations, or potentiometric surface, is then plotted on a base map and equipotential lines are drawn, resulting in the construction of a potentiometric surface contour map. The direction of ground water flow is then indicated as being perpendicular to the equipotential lines in a direction from higher to lower head.

In order to gather the needed ground water elevation data, it is important to know the elevation, above mean sea level, of the measuring point at each well, and to make precise depth-to-water measurements in each well. The elevation of the top of the casings (TOC) at the PROTECO Facility have been determined by a licensed surveyor to 0.01 foot accuracy. Accurate depth-to-water measurements will be made with a transistorized water level indicator calibrated in feet, aided by mechanical ruler measurements to 0.01 foot prior to quarterly well sampling. Once the depth to water in the well has been measured, this value is subtracted from the known elevation of the measuring point at the top of the well casing. The resulting value is the elevation above mean sea level of the water in each well. These values are then used to construct the potentiometric surface map. A potentiometric surface map of this kind will be produced from data collected at the PROTECO Facility and will be updated annually.

DETERMINATION OF GROUND WATER FLOW RATE - The rate at which ground water flows through any given geologic material can be estimated by the use of a modified form of Darcy's Law. The resulting equation is as follows:

$$V = \frac{-KI}{n}$$

where: V = the average linear velocity of the ground water (ft/day)

K = the hydraulic conductivity of the geologic material through which the ground water is flowing (ft/day)

I = the hydraulic gradient [the difference in height (ft) of the potentiometric surface between the two measuring points, divided by the horizontal distance (ft) between the two measuring points].

n = the effective porosity of the geologic material through which the ground water is flowing.

Laboratory grain size analyses have been conducted on samples collected during the drilling of test borings at the PROTECO Facility. Such analyses have provided information which is useful in determining a (K) value for the above equation.

WELL EVACUATION METHOD - Given the small diameter of the wells and the associated low yield characteristics of each well, the proposed method for well evacuation is manual bailing. Pumping methods are not feasible due to the extremely rapid drawdown rates observed in the monitoring wells. Manual bailing will be accomplished with the use of 1 1/2-inch diameter, three foot, bottom-loading, teflon bailers with a check valve. Each well will have a dedicated bailer in order to prevent cross-contamination between wells.

Before each bailer is dedicated to a well, it will be properly decontaminated. The decontamination procedure is as follows:

non-phosphate detergent wash
tap water rinse
acetone rinse
pesticade grade hexane rinse
10% hydrochloric acid rinse
deionized water rinse

The bailers are then allowed to thoroughly air dry before use.

When bailing a well, an attempt will be made to remove the standing water from the top of the water column to the bottom. In this way, the possibility of any standing water remaining in the well is drastically reduced. Furthermore, bailing will proceed at a rapid enough pace to draw the water down and cause the well to go dry. In order to facilitate this effort, a tripod for lowering and raising the bailer into and out of the well should be utilized. Such appartus will also help keep the teflon cord clean by coiling it on a spool, rather than on the ground, and reduce the risk of introducing contaminants into the well.

SAMPLE COLLECTION - Once the ground water monitoring wells have been adequately evacuated, they are ready to be sampled. The dedicated bailer used to evacuate each well will also be used to retrieve the samples. Prior to use for evacuation and sampling, each bailer will be decontaminated and stored in the following manner:

    non-phosphate detergent wash
    tap water rinse
    acetone rinse
    pesticide grade hexane rinse
    10% hydrochloric acid rinse
    deionized water rinse

The bailers are then allowed to thoroughly air dry before they are wrapped in aluminum foil. Between sampling events, the bailers are stored in the PROTECO office.

Because the ground water monitoring wells at the PROTECO Facility are so slow to recover, a considerable amount of time may be allowed to pass between the completion of well evacuation and the commencement of sample collection. For this reason, it is possible that recharged water resting at the top of the water column may go through a slight chemical alteration as a result of contact with air in the well casing. To minimize this effect, at least three bails of water will be wasted onto the ground before any ground water samples are retained. This practice will also tend to rinse out any water which remains in the bailer after well evacuation. A minimum of seven liters should be sampled

from each ground water monitoring well. The ground water samples are poured from the bailers directly into one liter, wide mouth, pre-sterilized glass and plastic bottles provided by the laboratory. The sample bottles are sterilized at the laboratory by washing in HNO_3 and then rinsed with distilled water. Each sample is preserved appropriately i.e. cooling, filtering, acidification, etc., immediately upon sample retrieval. Table 5 lists the bottle types and preservation requirements for the various parameters. All samples will be delivered to the laboratory the same day as sampling occurs.

ANALYTICAL PROCEDURES - PROTECO is presently using Environmental Quality Laboratory (EQ Lab) in Santurce, Puerto Rico to analyze ground water samples collected in conjunction with the ground water monitoring program. EQ Laboratory uses only EPA approved methods for all sample preparation and analyses.

EQ Lab will perform each analysis within the prescribed holding time for each parameter. Table 5A lists the holding times for the various parameters as outlined in CFR 40, Part 136, Table II.

All analyses will be carried out in the laboratory with the exception of a few physical parameters such as specific conductance, pH and salinity. These parameters can undergo significant alteration due to temperature change, exposure to the atmosphere and preservatives. For this reason, these parameters will be analyzed immediately upon sample retrieval using portable field meters.

For metals, both total and dissolved metal analyses will be performed. The total metal analysis will be performed by the total recoverable procedure, as described in "Methods for the Chemical Analysis of Water and Wastes". This procedure will yield a total metal concentration value in a sample which has not been filtered before acidification. For the dissolved metal analysis, ground water samples will be filtered through a 0.45 micron filter before acidification. This procedure will yield the dissolved metal concentration of a sample.

TABLE 5
Preservation Requirements

Preservation Method	Bottle Type	Volume Required (ml)	Parameters
Fix sample with HNO_3 to a ph < 2	Plastic or Glass	2,000	arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, iron, manganese
Cool the sample to 4^OC	Plastic or Glass	1,000	pH, specific conductance
Cool the sample to 4^OC and fix with H_2SO_4 to pH < 2	Glass with Teflon Cap	1,000	Total organic carbon (TOC)
Cool the sample to 4^OC and fix with H_2SO_4 to pH < 2	Glass	1,000	Phenols
Cool the sample to 4^OC	Glass with Teflon Lined Septums	40	Volatile Organics
Cool the sample to 4^OC	Plastic	500	Fluoride .
Cool the sample to 4^OC	Glass with Teflon Cap	500	Lindane

TABLE 5A
HOLDING TIMES FOR LABORATORY ANALYSIS

Parameter	Holding Time
Arsenic	6 Mos.
Barium	6 Mos.
Cadmium	6 Mos.
Chloride	28 Days
Chromium	6 Mos.
Fluoride	28 Days
Iron	6 Mos.
Lead	6 Mos.
Manganese	6 Mos.
Mercury	28 Days
Nitrate	48 Hours
Selenium	6 Mos.
Silver	6 Mos.
Sodium	6 Mos.
Sulfate	28 Days
Phenols	28 Days
pH	NA*
Specific Conductivity	NA*
Total Organic Carbon	24 Hours
Total Organic Halogen	24 Hours
Volatile Organics (Aliphatic)	14 Days
Volatile Organics (Aromatic)	7 Days
Pesticides	7 Days
Coliform Bacteria	6 Hours
Radium	6 Mos.
Gross Alpha	6 Mos.
Gross Beta	6 Mos.

*Parameters will be measured immediately upon sample retrieval.

For all other inorganic parameter, sample preservation will be carried out with the intention of preserving and measuring the total concentration of each parameter in the sample. The sample preservation techniques to be employed for the various parameters are listed in Table 5 shown in the previous section.

Analytic methods to be used for each parameter are listed in Table 7.

TABLE 6
PARAMETERS AND ANALYTICAL METHODS

PARAMETER	ANALYTIC METHOD
Arsenic	206.3[1]
Barium	208.1[1]
Cadmium	213.1[1]
Chromium	218.1[1]
Fluoride	340.2[1]
Lead	239.1[1]
Mercury	245.1[1]
Nitrate	352.1[1]
Selenium	270.3[1]
Silver	272.1[1]
Endrin	608[2]
Lindane	608[2]
Methoxychlor	608[2]
Toxaphene	608[2]
2,4-D	608[2]
2,4,5-TP Silver	608[2]
Radium	*
Gross Alpha	*
Gross Beta	*
Coliform Bacteria	908[3]
Chloride	325.3[1]
Iron	236.1[1]
Manganese	243.1[1]
Phenol	420.1[1]
Sodium	375.3[1]
Sulfate	273.1[1]
Total Organic Carbon	415.1[1]

TABLE 6 (cont'd.)

Total Organic Halogen	450.1[4]
Ethylbenzene	602[5]
Chloroform	601[5]
Toluene	602[5]
Benzene	602[5]
Methylene Chloride	601[5]
Xylene	601[5]
1,1,1-Trichloroethane	601[5]
1,1-Dichloroethane	601[5]
1,2-Transdichloroethylene	601[5]
Trichloroethylene	601[5]
Temperature	NA[+]
Specific Conductance	NA[+]
pH	NA[+]
Salinity	NA[+]

[*]See Appendix B for a complete description of the analytical method employed by Teledyne Isotopes.

[+]Parameters are measured using portable test meters immediately upon sample retrieval.

[1]"Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, March 1983.

[2]"Methods for Benzidene, Chlorinated Organic Compounds, Pentachlorophenol and Pesticides in Water and Wastewater", U.S. EPA, September, 1978.

[3]"Microbiological Methods for Monitoring the Environment, Water and Waste, 1978", EPA-600/8-78-017, U.S. EPA.

[4]"Method for Organochlorine Pesticides and Chlorophenoxy Acid Herbicides in Drinking Water and Raw Source Water" CERI, EPA, Cincinnati, Ohio.

[5]"Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater", 40 CFR, Part 136, 1984, Appendix A.

VI. CHAIN-OF-CUSTODY AND SAMPLE SHIPMENT PROCEDURES

Proper chain-of-custody procedures will be followed for all ground water sample handling from the time of collection through final analyses at the laboratory. These procedures are necessary to insure the integrity of the sample through its various phases of possession transfer. It accomplishes this by providing a mechanism to trace the possession of the sample until the final analyses results have been reported. In order to achieve this, the sample must be in the responsible parties' physical possession, and secured in a manner that prevents tampering by unauthroized personnel. A number of mechanisms will be followed to guarantee that the above-mentioned criteria have been met, and include the following elements: (1) sample labels, (2) chain-of-custody seals, (3) a chain-of-custody record form, (4) a sample analysis request sheet, and (5) sample shipment procedures.

1. Sample Labels - Sample labels are very important for identifying where each sample has been collected from. The labels will be made from gummed paper and will be filled out and affixed to the bottle in the field just prior to sample collection. It is important that this order be followed, because once the cool ground water is placed into the sample bottle, water will begin to condense on the bottle, making it difficult to affix the label at that time. It may also be helpful to cover the label with transparent tape to assure that it won't come off during sample shipment. The sample label will contain the following information: (1) sample number, (2) the collection date, (3) the name of the collector, and (4) the sampling location (i.e., well number).

2. Chain-of Custody Seals - These seals will be placed over the lid of the coolers containing the samples for shipment to the lab. The seals will be placed in a location where they will have to be broken in order to reach the samples. Each cooler being used to ship samples will have its own seal. The seal should have the collector's signature and the sampling date written on it. It is also important that this seal be placed onto the coolers before the samples leave the custody of the sample collector.

3. <u>Chain-of-Custody Record Form</u> - Chain-of-custody record forms will be filled out for each sample and will accompany the sample as it changes possession. Such documentation allows the sample possession to be traced from initial field collection to analysis. A copy of the chain-of-custody record form, showing all the information that will be required on the form, appears as Figure 4.

4. <u>Sample Analyses Request Sheet</u> - Sample analyses request sheets will be supplied by the laboratory and will serve as the major communication mechanism between the sample collector and the laboratory. They indicate which analyses are required for the samples. There will be at least two copies of each form; one will remain at the lab while the other will be returned to PROTECO and be retained as part of their records. A portion of the form will be filled out by the person collecting the sample in the field and will contain information pertaining to sample collection details (i.e., sample number and analysis requested, sample location, collection date and time, collector's name and phone number, etc.). The remaining portion of the form will be filled out by laboratory personnel and will contain the following information: name of person receiving the sample, laboratory sample number, date of sample receipt and analyses to be performed.

5. <u>Sample Shipment Procedures</u> - As indicated earlier, all samples will be shipped to the laboratory in coolers. The coolers will be packed at the site in a manner which assures safe transport of all sample bottles within. This will be accomplished by packing the sample bottles in vermiculite to prevent the bottles from falling over and/or breaking. Ice-filled plastic bags will be placed around the bottles within the vermiculite. Once the samples and the ice have been placed in the coolers, all excess space will be filled with additional vermiculite to hold the bottles exactly in place. The chain-of-custody record forms and sample analyses request forms will be placed inside the coolers. The coolers will then be sealed with heavy-duty tape and fitted with custody seals over the lid. All samples will be delivered to the lab by automobile within three hours of collection.

FIGURE 4

PROTECCION TECNICA ECOLOGICA, INC. (PROTECO)
FIRM DELIVERY

PONCE, PUERTO RICO

CHAIN OF CUSTODY RECORD FOR
GROUND WATER MONITORING PROGRAM

Lab Sample No. _____

_____

_____

_____

_____

Sampling Locations: _____

Collector's Name: _____ Telephone: (___) _____
signature

Date Sampled: _____ Time Sampled: _____ hours _____

Field Information: _____

_____

_____

Sample Receiver:

1. _____
name and address of organization receiving sample

2. _____

3. _____

Chain of Possession:

1. _____   _____   _____
signature   title   inclusive dates

2. _____   _____   _____
signature   title   inclusive dates

3.

QUALITY ASSURANCE QUALITY CONTROL

Ground water sampling will be carried out by a sampling team composed of PROTECO and EQ Lab personnel. Sampling will be supervised by J.E. Negron of PROTECO, a licensed chemist under the Commonwealth of Puerto Rico and will be conducted by PROTECO and EQ Lab chemists and technicians trained in proper sampling procedures.

Additionally, members of the PROTECO sampling team have participated in training seminars dealing with hazardous materials and waste management, chemical spill response and lab pack preparation.

During each sampling campaign, detailed records will be kept of all ground water monitoring well sampling procedures performed at PROTECO, including both well evacuation and sample collection details. This information will be recorded in two places; prepared field work sheets and a field log book. The field work sheet will primarily contain information pertaining to well preparation prior to sample collection. (Note: sample collection details will be kept on the chain-of-custody forms, the analyses request sheets, and in the field log book). This sheet will be filled out in the field to allow for a determination of the volume of water which must be removed from the well prior to sample collection. A copy of this work sheet appears as Figure 5.

In addition to the field work sheet, a detailed account of all ground water sampling procedures will be kept in a field log book. The primary purpose for utilizing such a book is to record enough information about the sampling procedures, so the entire event can be reconstructed without the need to rely on the sample collector's memory. The log book should consist of bound pages which are consecutively numbered. At a minimum, the following information will be included in the field log book for work done at each well:

o   sampling location (well number)
o   date and personnel present
o   purpose for sampling (i.e., quarterly sampling for detection
        monitoring background determination)

FIGURE 5

PROTECO
GROUNDWATER MONITORING WELL SAMPLING
FIELD WORK SHEET

1. Date: ____/____/____.

2. Personnel Present: _____, _____, _____, _____.

3. Well ID: #_____.

4. Does the well show any sign of tampering? Yes ____ No ____

    If yes, describe:

5. Depth of well (L_{wc}): _____ feet.

6. Depth to water (L_{dtw}): _____ feet.

7. Height of water column in well: _____ feet (Item 5 less Item 6).

8. Diameter of well: _____ inches or _____ feet.

9. Volume of standing water in well: _____ gallons (see section E-2d(2) of this plan).

10. Amount of water removed from well prior to sampling.

Date:	Time Start:	Time Stop:	# of Gallons Removed:

                                    * Total Gallons Removed: _____

* (This value must at least be equal to the volume noted in Table E-5.)

o   depth-to-water measurement

o   well evacuation method and volumes removed prior to sample
        collection

o   name of sample collector

o   time of sampling

o   sampling method

o   sample I.D. number (from lab analyses request sheets)

o   type of preservation used

o   appearance of each sample including the results of any analyses
        done in the field

o   sample shipment details (i.e., when shipped, by whom, to where)

o   analyses to be performed

The log book will be kept in a safe location at the PROTECO office when not being used in the field, and will always be available for inspection. All records pertaining to the ground water monitoring program will be retained at the PROTECO office for the life of the facility and during the post-closure care period.

EQ Laboratory employs a formal Quality Assurance Program in order to validate the data produced. In addition to utilizing duplicates, spikes and blanks, the laboratory analyzes quality control check samples. Once a year, they participate in the EPA Laboratory Performance Evaluation as a part of the NPDES monitoring program.

Enclosed is EQ Lab's Quality Assurance Manual which details the use of spikes, duplicates and blanks, performance evaluation samples, calibration procedures, equipment maintenance and personnel training.

STATISTICAL PROCEDURES - The use of statistical procedures in ground water monitoring programs is to compare ground water quality data from downgradient wells that have been potentially or actually affected by a subject facility with ground water quality data from background wells. These comparisons are based on statistical tests which determine if significant differences exist between the two sets of water quality data for individual parameters.

For detection monitoring the U.S.E.P.A. has recommended that a specific statistical test, Cochran's Approximation to the Behrens-Fisher (CABF) Students' t-test, be used for comparison of data between background and downgradient wells. The statistical test specified in Part 264 Appendix IV is applicable to those parameters that display approximately normal distributions. Normal distributions are those where the sample data have estimated coefficients of variation less than 1.0. (This criteria is intended to eliminate grossly non-normal data from being used in the test).

If the background data show an estimated coefficient of variation less than 1.0 for all monitoring parameters, then the statistical test specified by EPA my be applied. In accordance with Section 264.98(c)(2), Proteco will present the background data in a form necessary for determination of statistically significant increases. The following is required for each parameter:

For any set of data $(X_1, X_2 \ldots X_n)$ the mean is calculated by:

$$X = \frac{X_1 + X_2 \ldots + X_n}{n}$$

and the variance is calculated by:

$$s^2 = \frac{(X_1 - \bar{X})^2 + (X_2 - \bar{X})^2 \ldots + (X_n - \bar{X})^2}{n}$$

Where "n" denotes the number of observations in the set of data.

The test uses these data summary measures to calculate a t-statistic (t^*) and a comparison t-statistic (T_c). The T* value is compared to the t_c value and a conclusion reached as to whether there has been a statistically significant change in any indicator parameter.

The t-statistic for all parameters except pH and similar monitoring parameters is:

$$t^* = \frac{\bar{X}_m - \bar{X}_b}{\sqrt{\frac{s^2_m}{n_m} + \frac{s^2_b}{n_b}}}$$

If the value of this t-statistic is negative, then there is no significant difference between the monitoring data and background data. It should be noted that significantly small negative values may be indicative of a failure of the assumption made for test validity or errors have been made in collecting the background data.

T-statistic (t_c), against which t^* will be compared, necessitates finding t_b and t_m from standard (one-tailed) tables where,

n_b - the number of measurements

x_b - the mean of the measurements calculated by

$$\overline{X}_b = \sum_{i=1}^{n_b} Xi/n$$

in which X_i is the measurement i of parameter X

S_b - the standard deviation of the measurements calculated by

$$Sb = \frac{\sum_{i=1}^{n_b} (X_i - X)^2}{n_b - 1}$$

CV_b - coefficient of variation of the measurement calculated by

$$CV_b = s_b/\overline{X}_b$$

Once the background values have been established, the statistical test is performed on each parameter with data obtained from each downgradient monitoring well for samples collected at least semi-annually according to Section 264.97(1)(i). This is done to determine whether the difference between the mean of the constituent at each well and the mean background value is significant at the 0.05 level.

CABF statistical test procedure is outlined in Appendix IV of 40 CFR Part 264. The procedure is as follows:

Using all the available background data (n_b readings), calculate the background mean (X_b) and background variance (s_b^2). For the single monitoring well under investigation (n_m reading), calculate the monitoring mean (X_m) and monitoring variance (s_m^2).

t_b = t-tables with (n_b-1) degrees of freedom, at the
0.05 level of significance.

t_m = t-tables with (n_m-1) degrees of freedom, at the
0.05 level of significance.

Finally, the special weightings W_b and W_m are defined as:

$$W_b = \frac{s_b^2}{n_b} \quad \text{and} \quad W_m = \frac{s_m^2}{n_m}$$

and so the comparison t-statistic is:

$$t_c = \frac{W_b t_b + W_m t_m}{W_b + W_m}$$

The t-statistic (t^*) is now compared with the comparison
t-statistic (t_c) using the following decision-rule:

If t^* is equal to or larger than t_c, then conclude that there most
likely has been a significant increase in this specific para-
meters.

If t^* is less than t_c, then conclude that most likely there has
not been a change in this specific parameter.

The t-statistic for testing pH and similar monitoring parameters
is constructed in the same manner as previously described except the
negative sign (if any) is discarded and the caveat concerning the
negative value is ignored. The standard (two-tailed) tables are used
in the construction t_c for pH and similar monitoring parameters.

If t^* is equal to or larger than t_c, then conclude that there mot
likely has been a significant increase (if the initial t^* had been
negative, this would imply a significant decrease). If t^* is less than

A standard table for t-values in one- and two-tailed tests is provided in Table 7.

BACKGROUND VALUE ESTABLISHMENT - Background values for each regulated unit list of parameters will be established through a quarterly sampling program conducted at the background monitoring location.

At each quarterly sampling, samples will be collected from the background location and four replicate measurements for each of the listed indicator parameters will be obtained for each sample. This will document any variations that are a result of the analytical procedures. These four replicate measurements will then be averaged to arrive at one average value for each parameter for that sampling campaign. A similar procedure will be followed for each quarterly sampling, resulting in the generation of four (4) average quarterly values for each parameter. These four values will then be averaged to produce one average annual value for each parameter. This procedure is designed to take into account any seasonal variations which may occur in the vicinity of the PROTECO Facility. Once these values have been established, they will be used in the specified statistical procedure to determine if statistically significant increases in background are occurring in the downgradient wells. This procedure will be repeated each year in order to update background values on an annual basis. In establishing background levels for a detection monitoring program, certain procedures have been followed that are described in the previous section under Statistical Procedures.

TABLE 7

Values of t-Statistic for One- and Two-Tailed Tests at a
Level of Significance of 0.05 (from Fisher and Yates).

Degrees of Freedom	t-values (one-tail)	t-values (two-tail)
1	6.314	12.706
2	2.920	4.303
3	2.353	3.182
4	2.132	2.776
5	2.015	2.571
6	1.943	2.447
7	1.895	2.365
8	1.860	2.306
9	1.833	2.262
10	1.812	2.228
11	1.796	2.201
12	1.782	2.179
13	1.771	2.160
14	1.761	2.145
15	1.753	2.131
16	1.746	2.120
17	1.740	2.110
18	1.734	2.101
19	1.729	2.093
20	1.725	2.086
21	1.721	2.080
22	1.717	2.074
23	1.714	2.069
24	1.711	2.064
25	1.708	2.060
30	1.697	2.042
40	1.684	2.021

APPENDIX A

5' LENGTH OF 4"ø
PROTECTIVE STEEL
CASING WITH LOCK

GROUND SURFACE

CEMENT SEAL

1.46'

0

BROWN GRAVELLY
SAND

10

49.5' OF 2" SCH. 40 PVC
(THREADED FLUSH JOINT)

YELLOW-BROWN SILTY
SAND

20

DEPTH, FEET (APPROXIMATE)

BACKFILL OF CEMENT AND
BENTONITE SLURRY.

30

40

YELLOW-BROWN SILTY
CLAY

BENTONITE SEAL

SAND FILL

50

10' OF 2"ø PVC
0.010" WELL SCREEN
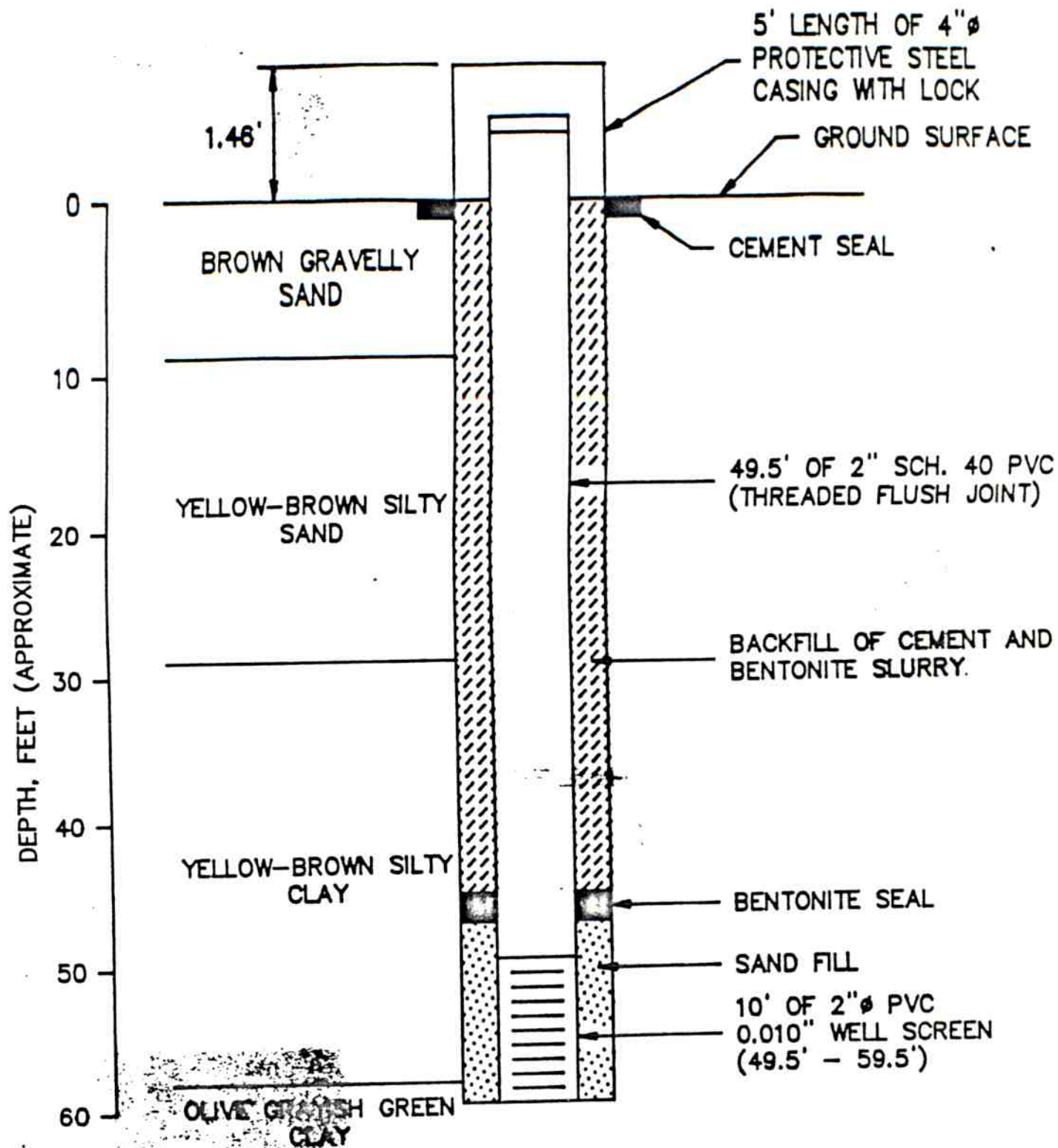(49.5' - 59.5')

60

OLIVE GRAYISH GREEN
CLAY

FIGURE 11

MONITORING WELL 18W85
CONSTRUCTION SPECIFICATIONS

PROTECO SITE
PEÑUELAS, PUERTO RICO
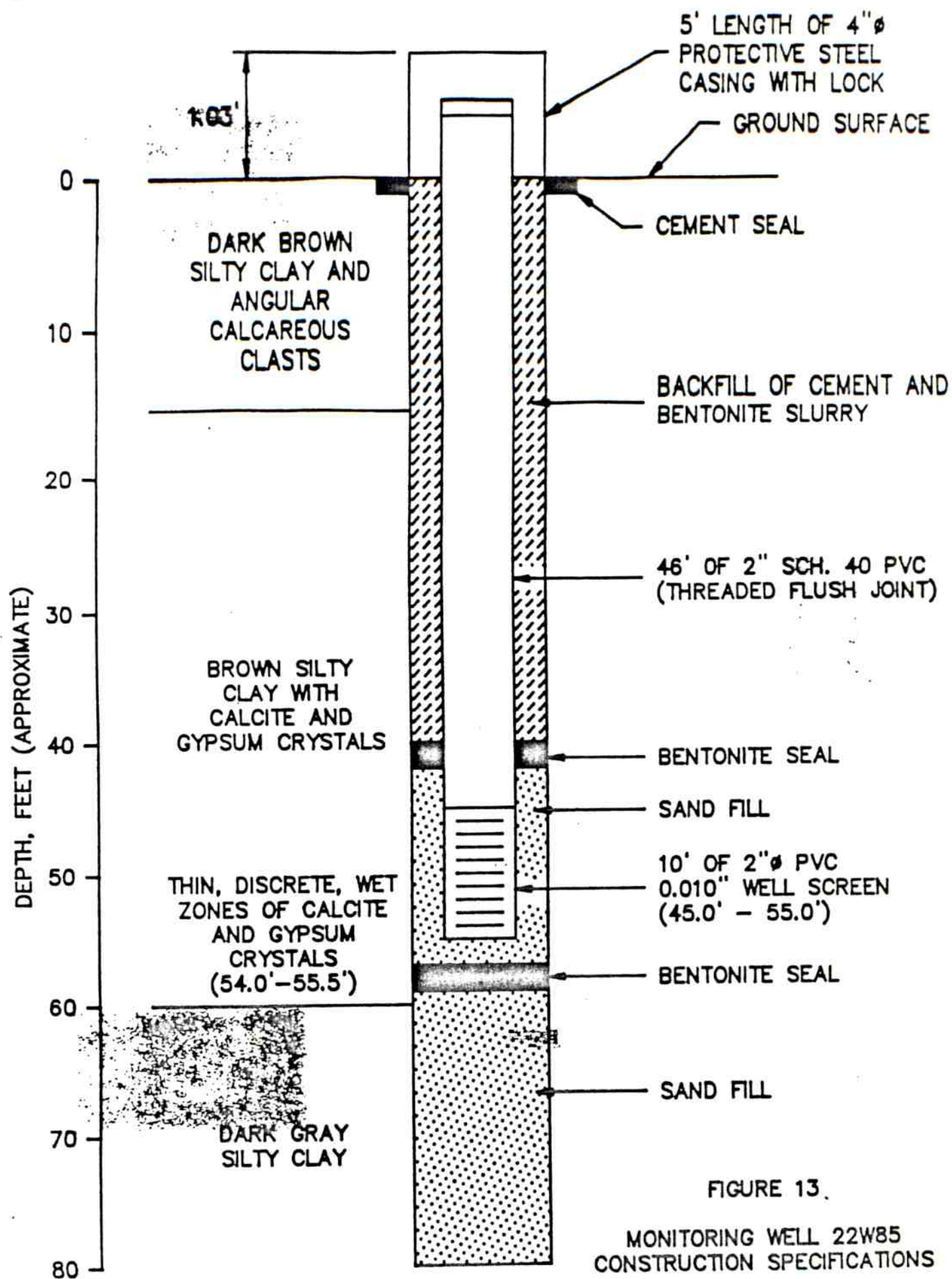
FIGURE 13.

MONITORING WELL 22W85
CONSTRUCTION SPECIFICATIONS

PROTECO SITE

4"ø STEEL CASING
W/ LOCKING CAP

GROUND SURFACE

1.0' CEMENT

33' OF 2" I.D. TEFLON
(THREADED FLUSH JOINT)

BACKFILL OF CEMENT AND
BENTONITE SLURRY

BENTONITE

SAND FILL

10' OF 2" I.D. TEFLON
0.010" WELL SCREEN
(29.0' – 39.0')

BENTONITE SEAL

BENTONITE AND
GRAVEL BACKFILL

BUFF SILTY
CLAY

BROWN SILTY
CLAY

DEPTH, FEET (APPROXIMATE)

0.4'

0

10

20

30

40

50

55

NOTE

1. CON_____D ON 11–3–85.

2. DEVELOPED ON 11–3–85.
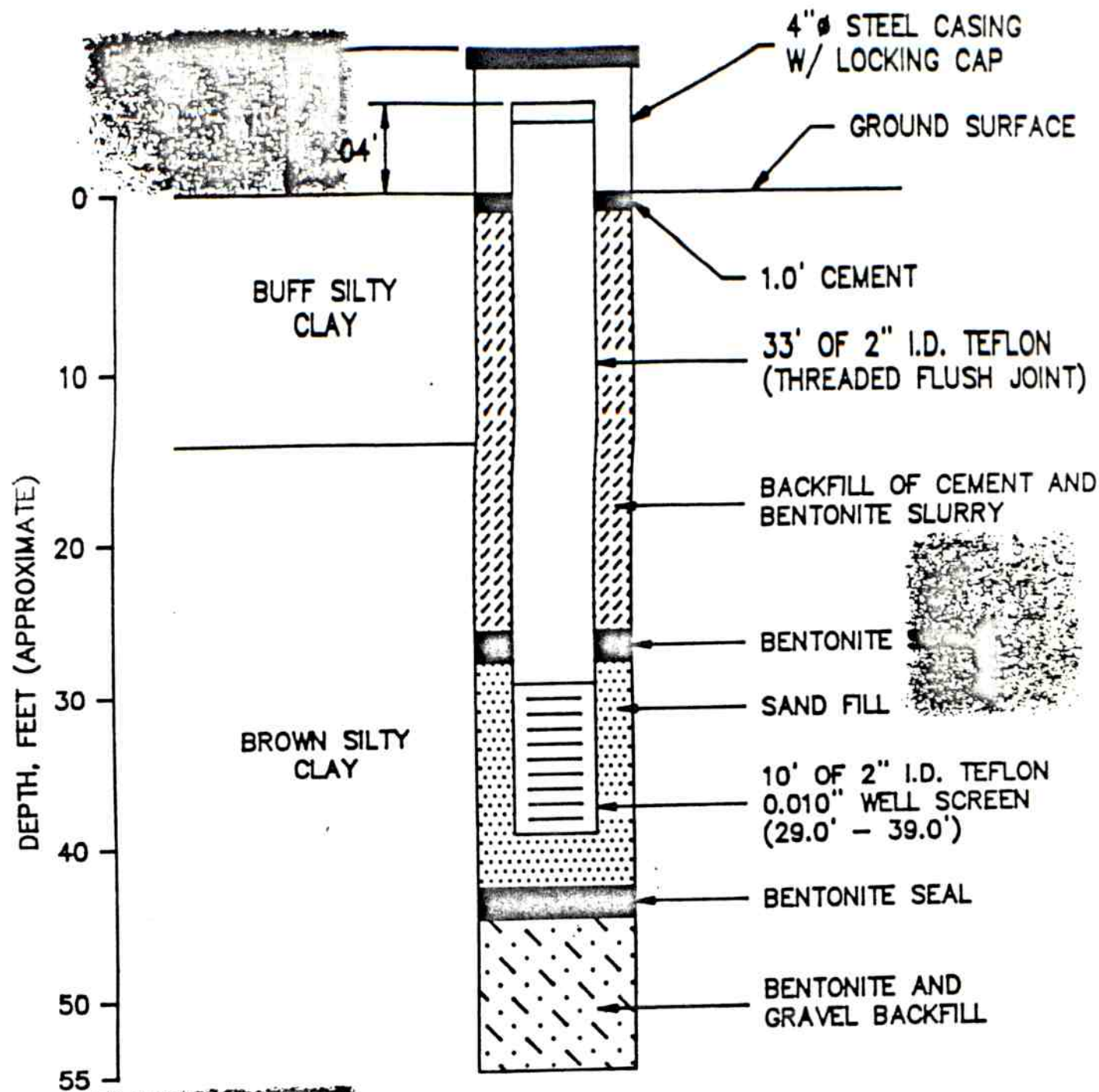
MONITORING WELL 23W85
CONSTRUCTION SPECIFICATIONS

PROTECO SITE
PEÑUELAS, PUERTO RICO

4"∅ STEEL CASING W/ LOCKING CAP

GROUND SURFACE

1.79'

1.56'

1.0' CEMENT

59' OF 2" I.D. TEFLON (THREADED FLUSH JOINT)

BACKFILL OF CEMENT AND BENTONITE SLURRY.

DEPTH, FEET (APPROXIMATE)

0

10

20

30

40

50

60

70

75

BROWN SILTY CLAY

DARK GRAY SILTY CLAY

BENTONITE SEAL

SAND FILL

10' OF 2" I.D. TEFLON 0.010" WELL SCREEN (59.0' - 69.0')

BENTONITE SEAL
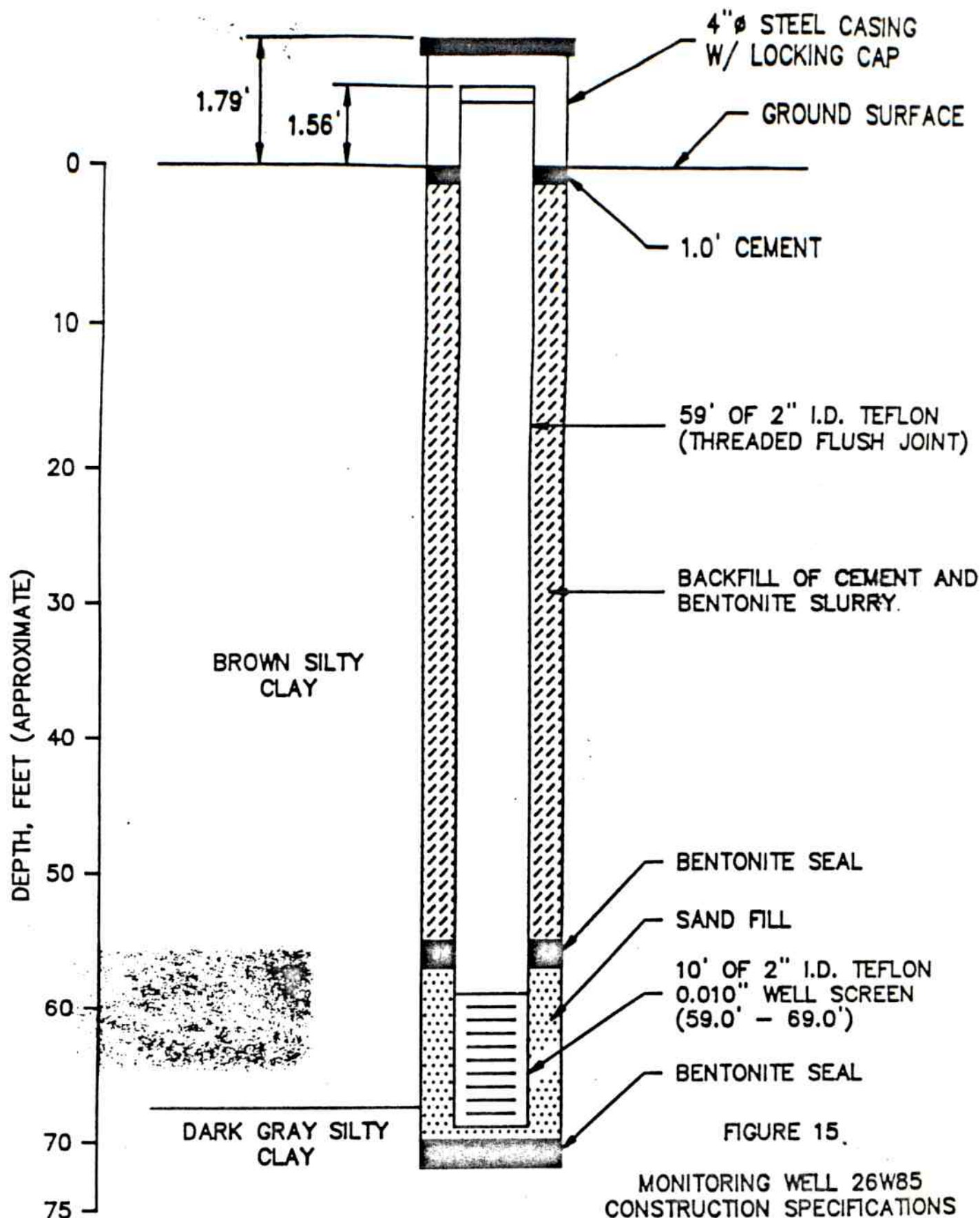
FIGURE 15.

MONITORING WELL 26W85 CONSTRUCTION SPECIFICATIONS

PROTECO SITE
PEÑUELAS, PUERTO RICO

NOTES: NOT TO SCALE

1. CONSTRUCTION COMPLETED ON 11-7-85

4"ø STEEL CASING W/ LOCKING CAP

GROUND SURFACE

1.58'

1.58'

1.0' CEMENT

65'-7" OF 2" I.D. PVC (THREADED FLUSH JOINT)

BACKFILL OF CEMENT AND BENTONITE SLURRY.

BROWN SILTY CLAY

DEPTH, FEET (APPROXIMATE)

BENTONITE SEAL

SAND FILL

10' OF 2" I.D. PVC 0.010" WELL SCREEN (64.0' - 74.0')

BENTONITE SEAL

BROWN TO GRAY SILTY CLAY

DARK GRAY SILTY CLAY
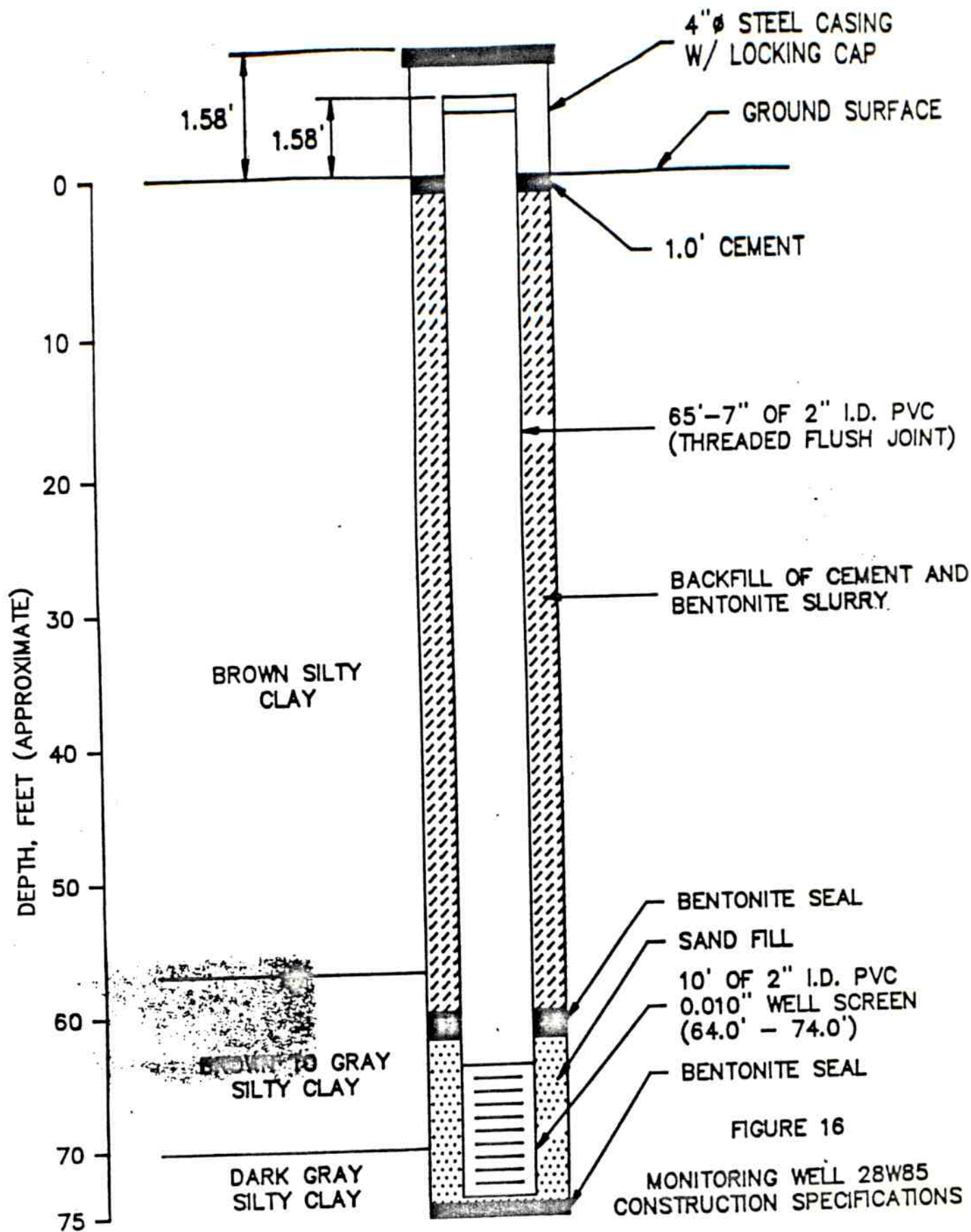
FIGURE 16

MONITORING WELL 28W85 CONSTRUCTION SPECIFICATIONS

PROTECO SITE PEÑUELAS, PUERTO RICO

NOTES: NOT TO SCALE

1. CONSTRUCTION COMPLETED ON 11-6-85.

4"ø STEEL CASING W/ LOCKING CAP

GROUND SURFACE

1.0' CEMENT

25.5' OF 2" I.D. TEFLON (THREADED FLUSH JOINT)

BACKFILL OF CEMENT AND BENTONITE SLURRY

BENTONITE SEAL

SAND FILL

10' OF 2" I.D. TEFLON 0.010" WELL SCREEN (23'-9" – 33'-9")

BENTONITE SEAL
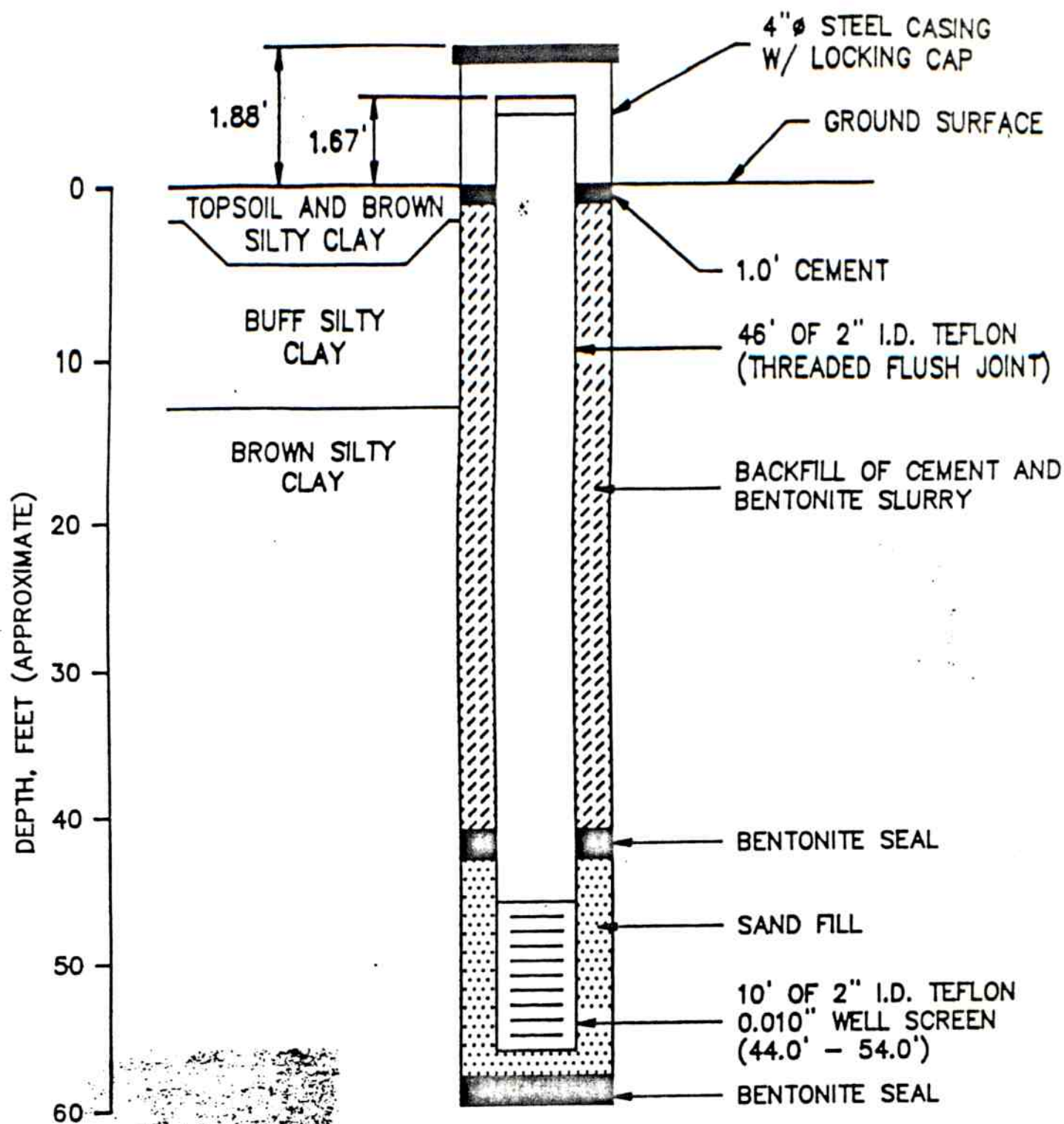
DEPTH, FEET (APPROXIMATE)

BROWN SILTY CLAY

1.88'
1.67'
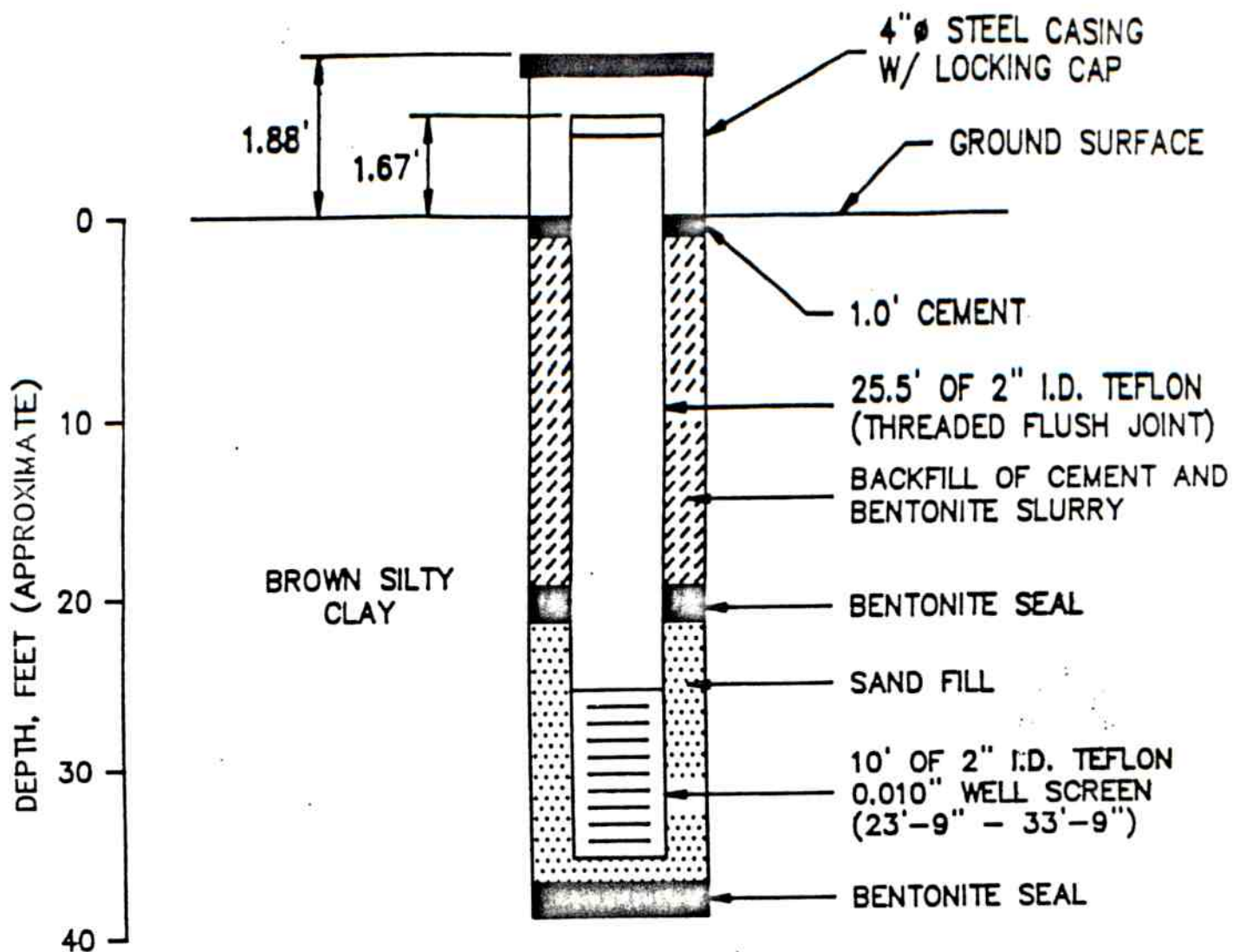
NOTES:

1. CONSTRUCTION COMPLETED 11-2-85.

2. DEVELOPED ON 11-3-85.

FIGURE 17

MONITORING WELL 29W85
CONSTRUCTION SPECIFICATIONS

PROTECO SITE
PEÑUELAS, PUERTO RICO

NOTES:

1. CONSTRUCTION COMPLETED ON 11-1-85.

2. DEVELOPED ON 11-3-85.

FIGURE 18

MONITORING WELL 30W85
CONSTRUCTION SPECIFICATIONS

PROTECO SITE
PEÑUELAS, PUERTO RICO

Appendix B

**TELEDYNE
ISOTOPES**

DETERMINATION OF GROSS ALPHA AND/OR GROSS BETA ACTIVITY

IN WATER SAMPLES

1.0 INTRODUCTION

The procedures described in this section are used to measure the overall radioactivity of water samples without identifying the radioactive species present. No chemical separation techniques are involved.

One liter of the sample is evaporated on a hot plate. Different volumes may be used if the sample has a significant salt content as measured by a conductivity meter, or if unusual sensitivity is desired. If requested by the customer, the sample is filtered through No. 54 filter paper before evaporation, removing particles greater than 30 microns in size. | 01/20/86

After evaporating to a small volume in a beaker, the sample is rinsed into a 2-inch diameter stainless steel planchet which is stamped with a concentric ring pattern to distribute residue evenly. Final evaporation to dryness takes place under heat lamps. Samples which appear to be hygroscopic are dried again under heat lamps just prior to counting. | 01/20/86

Residue mass is determined by weighing the planchet before and after mounting the sample. The planchet is counted for alpha and/or beta activity on an automatic proportional counter. Results are calculated using empirical self-absorption curves which allow for the change in effective counting efficiency caused by the residue mass.

Issue or Revision	Pages	Prepared By	Effective Date	Approved By Vice President Technical	Approved By Manager Quality Assurance
Rev.5	8		01/20/86		

H. Seter   Martin H. Ling

2.0 DETECTION CAPABILITY

Detection capability depends upon the sample volume actually repre-sented on the planchet, the background and the efficiency of the counting instrument, and upon self-absorption of alpha and beta particles by the mounted sample. Because the radioactive species are not identified, no decay corrections are made and the reported activity refers to the counting time.

The minimum detectable level (MDL) for water samples is nominally 1.6 picocuries per liter for gross beta at the 4.66 sigma level (1.0 pCi/ℓ at the 2.83 sigma level), assuming that 1 liter of sample is used and that 1/2 gram of sample residue is mounted on the planchet. These figures are based upon a nominal counting time of 50 minutes and upon representative values of 01/20/86 counting efficiency and background of 0.2 and 1.2 cpm, respectively. The MDL for gross alpha activity is nominally 2.3 picocuries per liter at the 4.66 sigma level (1.4 pCi/ℓ at the 2.83 sigma level) also assuming that 1 liter of 03/21/86 sample is used and that 1/2 gram of sample residue is mounted on the planchet. These figures are based upon a nominal 200 minute counting time and upon a 01/20/86 representative efficiency of 0.02 and a background of 0.1 cpm.

The MDL becomes significantly lower as the mount weight decreases because of reduced self-absorption. At a zero mount weight, the 4.66 sigma MDL for gross beta is 0.9 picrocuries per liter and the MDL for gross alpha is 0.3 picocuries per liter. These values reflect a beta counting efficiency of 0.38 and an alpha counting efficiency of 0.18.

3.0 SAMPLE SELECTION PROCEDURE

    (a) Using the Sample Receipt Form with the Teledyne Isotopes sample number, locate the sample (or sample group) in the Sample Receiving

PRO-022-65   DETERMINATION OF Ra-226 IN WATER SAMPLES

1.0 INTRODUCTION

The procedure describes the method of determining Ra-226 in water samples by the emanation technique. Radon-222 is equilibrated with the parent radionuclide , Ra-226,and then transferred through a closed system to an evacuated one-liter alpha chamber. The Rn-222 and daughters activities are measured in successive counting periods for an eighteen hour period.

2.0 DETECTION CAPABILITY

The minimum detectable level (MDL) for water samples is nominally 0.1 pCi/ℓ for Ra-226 at the 3.3 signa confidence level. This figure is based upon a sample volume of 1ℓ, a counting time of 200 minutes, and upon representative values of counting efficiency (for Rn-222 and two alpha emitting daughters) and background of 2.45 and 2.3 cpm, respectively.

3.0 SAMPLE SELECTION PROCEDURE

(a) Using the Sample Receipt Form with the Teledyne Isotopes sample number, locate the sample (or sample group) in the Sample Receiving and Storage Room. Transport the sample(s) to the Gas Analysis Laboratory.

(b) Begin filling out the Calculation Sheet -- Ra-226 Gas Counting form, entering the customer name, the sample number, sample collection date, the sample preparation date and the initials of the analyst.

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Issue 1976	4	J.D. Martin	1976	1976	_J. Martin_
Rev. 05/28/81	3	J. D. Martin	05/28/81	05/28/81	

DETERMINATION OF RADIUM-228

IN WATER SAMPLES

1.0 INTRODUCTION

This procedure presents a radiometric method for determining Ra-228 activity in water samples. Stable barium carrier is added to the sample and radium is co-precipitated with barium sulfate. The precipitate is collected by vacuum filtration and is mounted on a nylon planchet. The planchet is counted on a β-γ coincidence system for the 909-967 KeV complex peak of the supported daughter product Ac-228. This method is similar to that developed by McCurdy and Mellor at Yankee Atomic Electric Company, Westborough, Massachusetts.

01/20/83

2.0 DETECTION CAPABILITY

Detection capability depends upon sample size, chemical yields during processing, the counting interval, and the efficiency and background of the counting instrument. In the present case radioactive decay need not be considered because the short-lived Ac-228 nuclide analyzed is supported by (in secular equilibrium with) its long-lived parent Ra-228.

The minium detectable level (MDL) for Ra-228 in water samples is nominally 1.0 pci/ℓ at the 4.66 sigma level. This figure is based on one liter of sample, a chemical yield of 0.9, and a counting interval of 500 minutes. A background of 0.03 cpm and an overall efficiency of 0.013 characterize the β-γ system for counting the Ra-228 daughter in the 906-967 KeV complex peak region.

01/20/83

Issue and Revision	Pages	Prepared By	Date	Effective Date	Approved By
05/28/81	5	H W Jeter	05/28/81	05/28/81	J D Martin